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Ministry of Agriculture

FEBRUARY, 1921.

PRINCIPAL CONTENTS.

(For Complete List of Contents see page xxiii.)

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CONTENTS.

THE JOURNAL
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MINISTRY OF AGRICULTURE

Vol. XXVII. No. 11.

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NOTES FOR THE MONTH.

The Ministry's New Offices.

The Ministry of Agriculture has now taken possession of the offices in Whitehall Place, which were occupied during the War by the Ministry of Munitions. These offices, which during their tenure by the Ministry of Munitions were known as Armament Buildings, were originally erected for the Ministry of Agriculture, and although there is not sufficient accommodation to house the whole of the present staff, their utilisation in conjunction with the old offices in Whitehall Place, enables most of the activities of the Ministry to be located in adjoining buildings.

The only portions of the Ministry which are now housed elsewhere are the Fisheries Division at 43, Parliament Street, and the Tithe Branch at 3, St. James's Square. The Agricultural Wages Board remains at 80, Pall Mall.

The Ministry's new telephone number is "Victoria 8700." The telegraphic address is "Growmore, Weststrand, London."

* * * * * *

Foot-and-Mouth Disease in the Midlands.

The serious outbreaks of Foot-and-Mouth Disease which occurred towards the end of December and in January in the Midlands are remarkable from several circumstances. The disease appeared in areas hitherto free from such visitations, and when the Ministry inquired into the causes it became evident that the infection must have been communicated by sending animals affected by Foot-and-Mouth Disease to a public market. The result was that many animals from the market which had been exposed to the disease were distributed over wide areas, thus rendering the whole country liable to the risk of infection.

(35267) P6/198. 12M. 1/21. M. & S.

Foot-and-Mouth Disease would involve a large reduction of the milk supply as one of its many serious consequences, and it is imperative that all who keep or deal in live stock should watch most critically the condition of all cattle in their possession, especially if the animals are to be exposed at market. Should any suspicious symptoms be detected, it is the duty of the owner to report immediately to the Police. Such report, it should be noted, is required by law. The symptoms to be looked for particularly are lameness, slobbering at the mouth, and an affection of the mucous membrane of mouth and tongue. Stock-owners who fail in their duty in this matter not only incur the risk of heavy fines and even of imprisonment, but also do a grave disservice to their country. On the other hand, their active co-operation with the Ministry in the task of eradicating this dangerous disease is a national service of great importance. The Ministry's efforts are rendered ineffectual if those responsible for the care of live stock disregard the regulations and fail to report. The owner's duty is merely to notify suspicious cases to the Police; the Ministry does the rest. The initial step towards remedy lies with the owners; their help, therefore, is essential.

* * * * * *

Outbreaks of Rabies: The Duty of the Public.

THERE is little doubt that the recent serious outbreaks of Rabies, which have necessitated the scheduling of enclosed areas in London and several English counties, are due only to neglect of regulations. The measures prescribed by the Diseases of Animals Acts are rendered useless if the public persists in careless disregard of precautions framed in the general interest. As long as dog-owners and others fail in their obvious duty, outbreaks of the disease must inevitably recur.

Careful observance of regulations, strict watch on the health of dogs, immediate report to the Police of any animals exhibiting suspicious symptoms will enable the trouble to be arrested. Dog-owners have the matter in their own hands, and if they will only cease to regard preventive measures as vexatious and unnecessary, and will do their best to aid the authorities, rabies would soon be unknown. Those who do not actually own dogs can also help by intelligent observation. Should they see a dog behaving in a suspicious manner, they ought to inform the Police, who will investigate the matter. Evasion of movement restrictions or muzzling orders cannot

be too severely condemned. It increases the risk of disease and augments a grave public peril.

* * * * * *

Journal Supplement on Official Seed Testing during 1919-20.

WITH this issue of the *Journal* is published a supplement (No. 20) entitled "Seed Testing During 1919-1920" (Price 4d. post free, from the Secretary, Ministry of Agriculture and Fisheries, Publications Branch. 10, Whitehall Place, London, S.W.1).

This is the Third Annual Report of the Official Seed Testing Station and covers the period from 1st August, 1919, to the 31st July, 1920. A brief interim report on the work was published in the issue of this *Journal* for February last.

The total number of samples dealt with during the year ended 31st July, 1920, was 22,903, exclusive of 800 small packet samples received from the Seed Control Branch of the Ministry. This figure shows a decrease of 3 per cent. on the corresponding figure for last year, but owing to a considerable change in the nature of the samples tested, much more work has been involved.

It was estimated that about 30,000 samples would be received during the season, and but for a considerable drop in the number of cereal samples this figure would probably have been reached.

The following table indicates the sources from which the samples were received (the figures for the previous season being given for comparison):—

		1919–20.	*1918–19.*
Seed firms ...	Number sending samples ...	751	808
	,, of samples received	18,696	13,450
Farmers, &c. ...	,, sending samples ...	689	2,467
	,, of samples received	1,391	4,541
Public Depts. ...	,, ,, ,, ,,	2,816	5,113
Total number of samples		22,903	23,604

A map included in the supplement compares to a certain extent with a map published in last year's report.* It is, however, of greater interest in that it shows directly the relation between the number of farmers in any county who have sent samples for test, and the acreage under arable cultivation.

The drop in the number of samples sent in by farmers is unsatisfactory, and makes it desirable to emphasise again that much more use of the seed testing facilities provided by the

* See this *Journal*, Vol. XXVI., p. 868.

Station might be made with advantage by the actual sowers of seed.

The general quality of the seeds examined during the period under consideration was good. It is satisfactory to note a gradual improvement in the quality of grass and clover seeds submitted for test, and that the proportion of English grown clover seed samples received at the station shows an increase over previous years.

NOTE.—It is hoped that the Seed Testing Station will have been moved to the National Institute of Agricultural Botany at Cambridge before the beginning of the 1921-22 season. The present address is 18, Leigham Court Road, Streatham Hill, London, S.W.16, to which all samples and communications relating to seed testing should be addressed.

Particulars as to size of sample required and fees payable are set forth in :—

(*a*) *Food Production Leaflet No.* 47 (issued for the use of farmers). This leaflet also contains the text of the Testing of Seeds Order. Copies may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

(*b*) *Notice to Seedsmen* (184/C.S.), obtainable from the Seed Testing Station.

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Acreage and Live Stock Returns.

THE Report on the Acreage and Live Stock Returns for 1920, which has just been issued by the Ministry, refers to the large reduction in the acreage of crops and grass, which amounted in 1920 to 240,000 acres, following a similar loss in the preceding year. This represents a great acceleration in the reduction in the area of land used for agricultural purposes, which has been taking place for many years, and is attributed partly to the extension of building schemes in the last two years, but mainly to the fact that during the war a considerable area of agricultural land was taken for camps, aerodromes, munition works, &c. These deductions did not show themselves at the time, as concurrently additional areas of land were brought into cultivation. Following the cessation of hostilities some of this additional land, which had been used for food production merely as a war measure, was withdrawn, with the result that the loss of land for camps, munition works, &c., has now become manifest. Another cause of loss is the

extensive use of fields for allotments. The proportion of the cultivated area under the plough in 1920 was slightly less than in 1919, but was still somewhat greater than twenty years ago; while the proportion of the total cultivated area which was under corn was 24⅓ per cent. against only 21¼ per cent. in 1914, and the proportion under other arable crops was well maintained. In comparing the acreage of crops in 1920 with the average of the three years 1911-13, it is shown that the acreage of corn per 1,000 acres of cultivated land was increased chiefly in the counties where the bulk of the land is under pasture, and showed least progress in the specially arable counties where the margin for possible extension is relatively small.

As regards the number of separate holdings, the Returns show that the number was increased in 1920 for the first time for several years, the number of small holdings being increased from 272,568 in 1919 to 274,796 in 1920.

Perhaps the most striking feature in the returns in 1920 was the heavy reduction in the number of cattle and sheep. The decline in the number of cattle was about 650,000, which was mainly due to a large reduction in the number of calves being reared as a result of the disproportionately high prices which were paid for calves for slaughter during the year. The number of cows and heifers in milk or in calf was, however, still at such a level that the herds of the country could be brought up to their recent numbers fairly quickly if farmers are convinced that the prices of meat and milk are such as will yield a moderate return for the capital and energy which must be invested in the enterprise. The number of sheep last year was the smallest on record, and the restoration of the flocks of the country to their former level must of necessity be slow as the ewe flock was correspondingly small; but the decontrol of prices of fat sheep which took place during 1920, combined with the high prices which flockmasters received for the wool clip of 1920, should encourage more breeding. Pigs, on the other hand, were increased in numbers, there being 15½ per cent. more breeding sows in England and Wales in 1920 than in 1919.

THE AGRICULTURE ACT, 1920.

THE Agriculture Act, which received the Royal Assent on the 24th December last, came into operation on the 1st January. The Act consists of two main parts, of which the first contains amendments of the Corn Production Act, 1917, and the second contains amendments of the Agricultural Holdings Acts.

Part I.

1. Part I of the Act makes permanent the temporary provisions of the Corn Production Act, 1917, including the provisions as to agricultural wages and the enforcement of proper cultivation. Provision is, however, made for terminating the operation of that Act, as amended by this Act, by means of an Order in Council to be made on an Address presented to the Crown by both Houses of Parliament, but subject to the condition that the Order shall not take effect until the expiration of the fourth year after the date on which it is made. (Section 1.)

2. Instead of the fixed guaranteed minimum prices fixed by the Act of 1917, minimum prices in future are to be based on the following minimum prices for the standard year (1919), viz.: wheat 68s. per quarter of 504 lb., and oats 46s. per quarter of 336 lb. These are the minimum prices recommended by the Royal Commission on Agriculture and are based on the cost of production in the standard year. Minimum prices for 1921 and subsequent years are to be fixed by three Commissioners, and are to rise or fall in comparison with the above prices for the standard year in the same proportion as the cost of production rises or falls in comparison with the cost for the standard year. The Commissioners are to be appointed, one by the English and Scottish Departments of Agriculture jointly, one by the Treasury, and one by the Board of Trade. (Sections 2 and 3.)

3. The provisions of Section 9 of the Act of 1917, which deal with the enforcement of proper cultivation, are re-enacted with substantial modifications and amendments by Section 4. The principal amendments are as follows:—

(*a*) The power to enforce the breaking up of pasture has been abandoned and the control of cultivation is limited to securing, by service of appropriate notices, the maintenance, so far as practicable, of land, whether arable or grass, "clean and in a good state of cultivation and fertility and in good condition," and the improvement of existing methods of cultivation, where production of food can in the national

interest be thereby maintained or increased "without injuriously affecting the persons interested in the land." A right of appeal to an arbitrator is provided to determine whether the notice is properly served. Such notice may not interfere with the discretion of the occupier as to the crops to be grown.

(*b*) A new power is given to require the landlord or tenant according to their respective responsibilities to execute repairs which are necessary to secure proper cultivation. If a landlord is required to execute repairs and fails to comply, the tenant may be authorised by the Minister to execute the works and recover the cost from the landlord. Notices to execute repairs are also subject to an appeal to arbitration.

(*c*) Unreasonable failure to comply with a notice served under this section is punishable by fine, and a County Agricultural Committee acting on behalf of the Minister is entitled to execute the work and recover the cost. This procedure is substituted for the provisions in the Act of 1917 enabling the Minister to determine tenancies or take possession in a case of default.

(*d*) Cases have occurred in which good husbandry and food production have been prejudiced by the gross mismanagement of an estate, and the Minister is empowered in such cases, after consultation with the County Agricultural Committee and full inquiry, to make an order appointing a receiver and manager to act on behalf of the owner with wide powers of management. An appeal lies to the High Court against such an order.

(*e*) Provision is made for dealing with the nuisance caused by the growth of weeds on land which cannot be dealt with under the provisions relating to the enforcement of good husbandry, on account of the land not being under cultivation, as, for instance, on roadside and railway embankments.

4. Section 6 establishes a separate agricultural wages administration for Wales on the lines of the Scottish scheme under the Act of 1917.

Part II.

5. The Act, whilst preserving in all circumstances the right of a landlord to give a tenant notice to quit, by Section 10 secures tenants against the loss consequent on eviction by extending the existing provisions with regard to recovery of compensation for disturbance. The general effect of the section is

that if a tenant is required to quit without any fault on his part, he will receive compensation for the loss, directly attributable to the quitting which is unavoidably incurred by sale or removal of his stock, &c., together with the expenses of the preparation of his claim. In order to simplify procedure and avoid disputes, this compensation is to be computed as equal to one year's rent of the holding, unless it is proved that the loss and expenses incurred exceed that amount, in which case the sum recoverable by the tenant will be the proved loss up to a maximum amount equal to two years' rent of the holding.

The Act, without setting up a rent tribunal, indirectly provides a method for readjustment of rent without the necessity of serving a notice to quit. The landlord will not be liable to pay compensation for disturbance if the tenant refuses to agree to an arbitration as to a proposed increase of rent and the landlord in consequence decides to determine his tenancy. On the other hand, the landlord will be liable to pay such compensation if he refuses a request by the tenant that there should be an arbitration as to a proposed reduction of rent and in consequence the tenant decides to leave.

The provisions of Section 10 are too long to be summarised in this Note, but an important provision is that which requires written notice by a tenant of his intention to claim compensation for disturbance to be given to the landlord one month before the termination of the tenancy.

6. Section 11 provides for payment of compensation for disturbance in the case of allotment gardens, to which the Agricultural Holdings Act, 1908, does not apply, and extends the Allotments and Cottage Gardens (Compensation for Crops) Act, 1887, to metropolitan allotments.

7. Section 12 applies to cottages on agricultural holdings which are held by agricultural labourers under the tenant of the holding the same principle of compensation for disturbance as is adopted in the Act as regards agricultural holdings, subject to certain special conditions.

8. Section 13 provides that a tenancy for a term of two years or upwards granted after the commencement of the Act shall continue as a yearly tenancy after the expiration of the term for which it was granted, unless a year's notice is given by either party of intention to terminate the tenancy. Any such notice given by the landlord may be the subject of a claim by the tenant to the benefit of the provisions of the Act relating to compensation for disturbance.

9. Section 14 removes a grievance in the case of a tenant of glebe land, who has hitherto been liable to removal in consequence of the death of the incumbent and places him in the same position with regard to compensation for disturbance as a tenant of other land.

10. Section 15 materially improves the position of a tenant as regards compensation for improvements. At present a tenant can only obtain compensation for permanent improvements if the landlord consents to their execution. Under the Act, if a landlord refuses consent to the making of any improvement, prescribed by regulation by the Minister as an improvement to which this provision is to apply, an arbitrator or the County Agricultural Committee can, after hearing the landlord's case, direct that the improvement shall be treated as an improvement for which consent is not required, but in that event the landlord will, as in the case of drainage, have the option of executing the improvement and charging an appropriate additional rent to the tenant.

As regards market garden improvements, the section contains provisions enabling an arbitrator or the Agricultural Committee to apply to a holding, or any part of a holding, the conditions known as "the Evesham Custom" under which the tenant who determines his tenancy is only entitled to compensation for market garden improvements if he can find another tenant willing to take his place and to undertake his liability for compensation.

11. Section 16 provides for compensation for a tenant who has continuously adopted a standard of farming or a system of farming which has been more beneficial to the holding than the standard or system (if any) required by his contract of tenancy. Section 19 provides a corresponding compensation for the landlord in the case of the deterioration of a holding by a tenant.

12. Section 18 enables a landlord to claim arbitration in respect of any breaches of contract by the tenant, and in this respect puts him in the same position as regards enforcement of his claim as that in which the tenant is under the Agricultural Holdings Act, 1908. All questions between landlord and tenant will be referable to arbitration, but particulars of a claim must be given within two months of the termination of the tenancy.

13. Under Section 28 notices to quit, other than a notice given by a tenant to a sub-tenant, if given after the 1st January, 1921, must be twelve month notices, unless the case falls within the

exceptions inserted in the section relating to land belonging to the War Departments, or to public undertakings, or where possession of land is resumed for purposes, other than agriculture, in accordance with a provision in the tenancy agreement.

14. In addition to the amendments specifically mentioned above, Part II of the Act comprises various other amendments of the Act of 1908, of a more technical character, which are desirable for improving the legal position as between landlord and tenant.

Part III.

15. Section 32 extends to cottages, provided free of rent for the use of an agricultural labourer as part of his remuneration, the statutory provisions which require cottages which are let to be kept reasonably fit for habitation.

The Act applies to Scotland with certain modifications, but does not apply to Ireland.*

* Copies of the Act may be purchased [price 6d., exclusive of postage] through any Bookseller or directly from H.M. Stationery Office at the following addresses:—Imperial House, Kingsway, London, W.C.2, and 28, Abingdon Street, London, S.W.1; 37, Peter Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 23, Forth Street, Edinburgh; or from E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

THE EMBARGO ON THE IMPORTATION OF CANADIAN STORE CATTLE.

DEPUTATION TO THE MINISTER OF AGRICULTURE.

THE Minister of Agriculture and Fisheries (The Right Hon. The Lord Lee of Fareham, G.B.E., K.C.B.) received on January 12th a deputation from the Joint Parliamentary Committee of the Co-operative Congress with regard to the existing embargo on the importation of Canadian store cattle. The deputation was introduced by Mr. A. V. Alexander, Secretary of the Joint Parliamentary Committee of the Co-operative Congress.

Mr. May, Joint Parliamentary Committee, in stating the case on behalf of the Co-operative Movement, drew attention to the fact that the movement represented upwards of 4,000,000 members. The risk of disease, it was urged, had long since been abandoned as a reason for the maintenance of the embargo; indeed the clean bill of health of Canadian cattle was unexampled in the history of that or any other country. Even if there had been disease, the embargo was never an effective protection because Canadian cattle by the thousand, and by the million, had in past years been slaughtered at the ports, and the hides, offal and manure distributed throughout the country. As Sir Robert Borden had said, there was much more reason for Canada placing an embargo on cattle from the United Kingdom than there ever was for this country placing an embargo on cattle from Canada. It was admitted that the consumers' demand for fresh-killed meat could, to a certain extent, be met by the landing of fat cattle and their immediate slaughter at the ports, but the consumers were entitled to the further advantage of cattle coming into the country to be " finished " and fed up to the same standard of quality as that of home-grown meat which at present was only available for those who had a long pocket. The recent depletion in the herds of the country, as shown by the returns of the Ministry of Agriculture, was further testimony to the necessity for removing the embargo. It had been stated that the various interests concerned were not agreed, but such an artificial atmosphere had been created round this subject that the

deputation wished to be informed what those interests were. Before the War, it was known that the Irish Party in Parliament had used their political influence to prevent the raising of the embargo. On the other hand, the Canadian authorities had stated that it was a matter of fiscal policy, and in this connection the Imperial aspect of the question could certainly not be overlooked. It was submitted that the only interests not fully agreed were either political interests or the interests of the British farmer, who, it was suggested, desired an immoderate return on his capital. Reference was made to the enhanced prices of both home-store cattle and home-killed meat, and it was urged that, if the embargo were continued and the Food Ministry's control of prices removed, the consumers would be in a serious position as between the farmers on the one hand and the Trust of meat importers on the other. The time had now come either for the Government to keep its promise made at the Imperial War Conference or to give some sound reason which would appeal to the intelligence and understanding of the general body of electors and citizens of this country.

Mr. Henderson, Canadian Cattle Association, referred to the statement that farmers were opposed to the removal of the embargo, and pointed out that farmers did not constitute more than 5 per cent. of the population. The only farmers who did not want Canadian cattle were those who had never handled them. The Scottish Farmers' Union and the Scottish Chamber of Agriculture were against the embargo; in fact, the only people who supported it were a few breeders, whose objection in Scotland on the grounds of disease seemed inconsistent with their action in importing cattle from England, where disease is known to exist at the present time. In the interest of food production, a supply of store cattle was necessary to fertilise the land; otherwise the production of cereals and potatoes must seriously diminish. It was probable that as many as 200,000 store cattle per annum would come in if the embargo were lifted. The situation would be met by the restoration to the Minister of a discretionary power to admit live animals from any part of the world.

Mr. Brown, Dunfermline Co-operative Society, on behalf of the distributive side of the Co-operative Movement, urged that the consumer did not want imported meat. The price of the home article, since decontrol, was, however, rising almost beyond the reach of many of the working classes. He

thoroughly agreed with what had been said by previous speakers, and hoped that the Government would see its way to remove an embargo which co-operatives considered was unjust to Canada.

Bailie Walker, representing the Glasgow Corporation, said that in that town there existed a great industrial population which was continually clamouring for home-grown meat, whereas 50 per cent. of the meat consumed was imported. A wharf had been built on modern lines for the reception of foreign animals, but the only animals which had as yet been landed there came from Ireland. If live cattle were admitted instead of frozen carcasses, not only would it reduce the cost of living but the valuable hides and offals would be available for the establishment of new industries in this country. In the interests of our great industrial masses, the embargo should be removed, even if the agricultural interest suffered to the exaggerated extent that was claimed.

Lord Lee, in reply, drew attention to the sharp difference of opinion which existed with regard to this important question. So far, however, as the representations which had reached the Ministry from responsible agricultural bodies were concerned, the agricultural interest of this country, at any rate of England and Wales, was overwhelmingly against the removal of the embargo. In any event, the matter did not rest within the executive discretion either of the Ministry of Agriculture or of the Government, as the removal of the embargo would require fresh legislation. In this connection and as an instance of the attitude of, at any rate, one House of Parliament, a private Bill was brought forward in the House of Lords last session, which proposed to deprive the Minister even of the very limited discretion at present conferred upon him by statute of admitting very exceptional animals of high pedigree value. Though opposed by the Government, the Bill was carried through the Upper House. This showed that the problem was not so simple as was represented, nor could the embargo be removed by a stroke of the pen. The Ministry had publicly endorsed the clean bill of health to which Canadian cattle were entitled, but Canada was not the only exporting country, and if legislation were proposed it would be impracticable to limit its operation to Canada alone. Primarily, of course, the Ministry had to regard this matter from the point of view of the interests of agriculture, but it was not oblivious to the other

important interests concerned. The interests of the community as a whole, and also the Imperial interests, had, of course, to be taken into consideration, and it was conceivable that, on balance, agricultural interests might in the last resort have to give way to some higher consideration. That, however, was a matter for the Cabinet and for Parliament. In any case, the Imperial aspect of the question would no doubt be fully discussed at the Imperial Conference this year.

The main argument advanced by the deputation seemed to have been that the removal of the embargo would result in a substantial increase in the supplies of fresh-killed meat. It had been suggested that as many as 200,000 stores a year might come in, though it was open to doubt whether so many would be available. Even if the whole of these beasts were used for fattening, and if they resulted in a net increase in the store cattle population of this country, they would represent but a minute fraction (less than 5 per cent.) of the total meat consumption of our population. In this connection, too little had been made of the fact that the ports were already open for the importation of Canadian or other cattle for immediate slaughter, and there were, apart from economic considerations, no limits or obstacles to the development of that trade, which would ensure for this country the hides and the offal to which reference had been made. With regard to the supply of home-grown stores, there had been recently not only a considerable reduction in the slaughtering of calves, but also a marked increase in the number reared, and the situation gave promise of an early return to normal, so far as the re-establishment and maintenance of our herds were concerned.

Returning to the question of disease, it was unfortunately true that England was at present afflicted with a number of outbreaks of foot-and-mouth disease, as to the origin of which there was no positive information, though many theories had been advanced. The Ministry had appointed a Committee, composed of eminent scientists, to concentrate on an effort to isolate and identify the virus, but such a baffling investigation was not likely to be completed in a short space of time. In the meantime, there was undoubtedly a real lack of confidence amongst stock owners in this country as to the risk of the infection of their herds, and if the embargo were removed the result would be to discourage home-breeding which was far more essential than importation, especially from the point of view of the milk supply. It was admitted that the present

infection did not come from Canada. On the other hand, the countries adjacent to us on the continent of Europe were infected with cattle disease to an unprecedented extent, and, bearing in mind the fact that any fresh legislation for removing the embargo could hardly be limited in its operation to the Dominion of Canada, it was not desirable to run the risk of fresh disease which the admission of store cattle would involve. One great protection which was enjoyed at present was the "moat" which surrounded these islands, and having that protection, which was conferred by Nature and confirmed by Act of Parliament, it would require a good deal more argument than had at present been advanced to justify any departure from the policy maintained under the existing law. At the same time, it was very desirable to keep an open mind on questions of this kind, particularly scientific questions, and in addition to referring the problems arising out of disease to a Scientific Committee, the question of the effect of the importation of store cattle on the general agricultural interests of this country was being referred, not only to the new Council of Agriculture for England, constituted under the Act of 1919, but also to the Agricultural Advisory Committee for England and Wales. Pending the official expression of the views of these responsible bodies, it was not desirable that the Minister should express any further opinion with regard to future policy, but at the present moment, and as at present advised, his view was that the time was not opportune for the introduction of the legislation that would be necessary to secure the end which the deputation had in view.

Mr. May, in thanking the Minister for receiving the deputation, said that the Minister's definite and detailed reply contained important points which would require the most careful consideration of the deputation before any further action were undertaken.

FOOT-AND-MOUTH DISEASE:

INTRODUCTION FROM ABROAD.

THE way by which foot-and-mouth disease is brought into Great Britain and similarly situated countries from time to time, notwithstanding the fact that into the former in particular the importation of susceptible live stock is prohibited, is as mysterious as it is interesting. The subject has given rise to spasmodic discussions, but the possibilities do not seem to have been methodically debated in relation to the actual facts, so far as they are known. The happenings from the beginning of 1919 have provided more material than in former years for a closer analysis of the subject. It is not claimed that the results bring finality to a question which for many years has baffled the best scientists in Europe, but it may be that by elimination they outline the direction to be followed in future inquiry.

It may be accepted as established that Great Britain freed from the disease in enzootic form is only invaded when the disease is prevalent on the Continent, particularly when it prevails in the north of France, Belgium and Holland. In the light of recent experience, it would also appear that the greater the prevalence, the more frequent are the invasions.

Live stock being excluded as a factor, it is not unnatural that suspicion should have fallen upon human beings coming from the Continent where the disease is raging, and on imported feeding stuffs and litter. It may be mentioned, however, to save further discussion, that the importation of hay and straw, except for exceptional purposes, has been prohibited since 1908, and that the position as regards foot-and-mouth disease has not apparently been modified in consequence.

Initial Outbreaks and Secondary Outbreaks.—For the purpose of analysis and discussion outbreaks of foot-and-mouth disease fall into two classes, initial outbreaks of invasion, and secondary outbreaks, which are local ramifications from the initially established centre. As regards the latter, investigation by the Ministry has seldom failed to establish satisfactorily the way by which disease has spread. Much useful information on this subject is available. It is with initial outbreaks of invasion, however, that this article is mainly concerned, and there have been 63 in the last 20 years. The term is applied to those outbreaks which arise after the country has been free from disease for more or less long periods, which are far in excess of what we have reason to believe represents

the viability of the virus inside or outside the bodies of animals—months or years, and to outbreaks occurring almost simultaneously in parts of the country very remote from each other—Surrey and Northumberland, for example—which have no possible connection with each other, except perhaps through the still mysterious agency whereby the virus travels long distances and in certain directions, this being apparently the same problem as that of invasion from without the country.

The above classification of outbreaks may at first sight appear somewhat artificial. It will be apparent that it is not so, however, if due consideration be given to the following facts :—

(*a*) That there is often an excessively long interval of time between the outbreaks—months and even years.

(*b*) That outbreaks may occur almost simultaneously at long distances from each other having no possible ordinary connection (feeding stuffs, men, &c.) with each other.

(*c*) That for the last 20 years the policy of immediately slaughtering all affected animals and actual contacts before virus can be freely manufactured by them and disseminated, has been almost exclusively followed, together with complete disinfection of infected premises both by chemical agents and prolonged isolation.

(*d*) That recurrences after re-stocking formerly infected premises with susceptible animals is practically unknown.

(*e*) That the same premises are almost never hit twice, as it were, by invasions after more or less long intervals.

(*f*) That the efficacy of the measures outlined in (*c*) would appear to be proved by (*d*) and (*e*).

In every outbreak it is customary for the Ministry's Inspectors to collect the fullest information possible regarding articles brought on to the place and their origin. Similarly, the recent movements of animals and human beings connected in any way with the premises are inquired into and recorded. Obviously, however, it is information of the kind in connection with initial outbreaks only which might throw light on the manner of invasion, and it is such information which has been utilised for the purposes of this article.

Whether Disease is communicated by Feeding Stuffs, Packing Materials and Human Beings.—These represent the communications between animals of the farm and the outside world, and it is not unnatural that they should have fallen under a sustained suspicion. The object of the inquiries which have been made over a period of years was to find whether any credible

factor repeated itself in a number of outbreaks, or whether any lines of evidence from a series of initial outbreaks would converge on one point, for example, on a cargo or consignment of feeding stuffs, &c. It may be said at once that it has not been possible to establish anything of the kind. It is true grave suspicion has sometimes rested on a certain article, mainly on account of its advent synchronising with the appearance of disease on the premises, but in almost every case further inquiry has shown that the same consignment has been distributed to many other premises where no disease has occurred. It is also correct that an occasional outbreak arose near camps in which soldiers from the Continent had been concentrated. On the other hand no actual communication was established between the soldiers and the premises which became infected. Moreover, initial outbreaks had been known to occur in the past in the same locality when there were no soldiers or other persons to suspect, and in the vast majority of cases no outbreaks arose near camps of the kind.

The most that can be said of the above evidence is that it is not in favour of the view that infection is generally brought to this country by men and such articles as have been mentioned, but in addition there is the fact that many initial outbreaks have occurred on premises far removed from others, the animals of which having received only foodstuffs grown on the place, and the attendants not having been off the place for weeks before disease appeared. The weightiest evidence, however, against men, foodstuffs, &c., being responsible for the importation of initial infection has arisen in the last year or so, during which the invasions have been exceptionally frequent. It will be shown later that invasions have repeated themselves during the last 20 years in more or less defined areas of the country, though not on the same premises, large parts of England and Wales, and the whole of Scotland and Ireland having escaped entirely or almost so (there has been one initial outbreak in Scotland, at Edinburgh, in the last 20 years). These immune areas receive the same class of foodstuffs, &c., and are visited by the same class of human beings, and it is almost inconceivable that over a period of 20 years certain areas could receive all the infected persons and things which came into the country, and others escape entirely, if persons and foodstuffs are generally responsible for the importation of infection. This is all the more remarkable when it is remembered that in over 80 per cent. of the outbreaks of anthrax, infection is conclusively shown to arise from imported

feeding stuffs and manures, and that the outbreaks follow the lines of distribution, sparing no parts of the part of the country in which they are used, Scotland for example, being as heavily hit in proportion as England.

If, then, the usual communications between the animals of the farm and the outer world do not account for the conveyance of something—virus of foot-and-mouth disease in this case—which arrives on farms with a certain amount of frequency, other possible methods of communication must be considered, even if they appear at first sight fanciful.

Distribution of Disease in Great Britain during the last 20 Years.—It has been previously stated in this article that certain parts of the country were hit, as it were, initially with much greater frequency than others, and that some habitually escaped altogether. The outbreaks have been examined over a period of 20 years, and a list of the initial ones, together with the exact dates and localities, has been compiled.

The counties in which two or more initial outbreaks have arisen in that period are as follows:—Bedford 3, Devon 2, Dorset 2, Durham 3, Essex 3, Hants 2, Kent 8, Lancaster 2, Lincoln 2, Northumberland 2, Somerset 5, Suffolk 2, Surrey 3, Sussex 5, Warwick 2, Wilts 3, Yorks (West Riding only) 4, Denbigh 2.

In the following counties initial outbreaks arose once in the same period:—Cambridge, Chester, Cumberland, Gloucester, Isle of Wight, Hertford, Leicester, Norfolk, Oxford, Stafford, Pembroke, Flint and Midlothian.

No initial outbreaks have arisen in:—Berkshire, Buckinghamshire, Cornwall, Derby, Herefordshire, Huntingdon, London, Middlesex, Monmouth, Northampton, Nottingham, Rutland, Shropshire, Westmorland, Worcester, Ridings of Yorkshire (except the West), or Isles of Scilly. None have arisen in Welsh counties except Pembroke and Flint, and none have arisen in Scotch counties except Midlothian.

From the above it will be seen that in the last 20 years about one-fifth of the counties of Great Britain were hit twice or oftener, the highest records being for Kent and the neighbouring county of Sussex, Somerset and the West Riding of Yorkshire; that in about one-eighth of the counties only one outbreak arose, and in the remainder there were no initial outbreaks. If, however, the counties are grouped according to locality, taking for example the area represented on the east and south by Sussex, Surrey, Hertfordshire, Bedford, Cambridge, Norfolk, Essex and

Kent, it will be seen that 27 (about 43 per cent.) of the 63 initial outbreaks in the last 20 years have appeared in this area. Taking the Southern section of the country represented by Hampshire, Dorset, Wiltshire, Somerset and Devon, 15 initial outbreaks (24 per cent.) have arisen there. In both groups there are areas, Cornwall and Middlesex for example, in which no such outbreaks have occurred. There are also small areas, for example a strip along the north coast of Wales in Carnarvon, Flint and Denbigh, where they have arisen at least often enough to be remarkable.

It does not seem likely from what has been said that the incidence of invasion in these areas can depend entirely on fortuitous circumstances, and it is possible that if the explanation of this incidence was forthcoming, it would also explain the method of invasion in general.

Air-borne Virus.—No support having been found for the ordinary methods of conveyance of virus, it seems justifiable to explore the possibility of the virus being air-borne for long distances, either by air currents or birds, or otherwise. As regards air currents, when affected cattle are allowed to remain alive on open pastures or at work, as is customary on the Continent for example, it is no uncommon thing to see strings of viscous slobber from the mouth whirled up into the air and dispersed into minute parts which disappear from sight. This material is known to be infective in infinitesimal doses, and it can therefore stand a high dilution. What becomes of it after it gets into the air is obviously a question which cannot be answered definitely. It is a fact, however, that even in this country where the official method of handling diseased animals —housing and almost immediate slaughter—gives few opportunities for virus to spread, ramifications in the direction of a strong prevailing wind have been occasionally observed to a distance of a few miles, and no ordinary communication could be traced by the minutest inquiry. Having regard to the distance which volcanic dust can be borne in the air it seems reasonable to believe that very small particles of infected mucus could be carried long distances by air currents, even in clouds, and be washed down in rain. The experiments of Blackley which showed that the air may be heavily charged with grass pollen, and that it might be carried thus as far as from Norway to this country, are of some interest, and it may be remarked that pollen from pastures in infected countries might be contaminated.

Accepting air-borne virus as possible, the next question which arises is, whether there exists more frequently anything in the

form of air pockets of negative pressure in the areas mostly invaded, which could account for the suspended virus descending to earth or water. These are problems which obviously should be discussed with those who are now exploring the air. As regards birds, it immediately suggests itself that if birds in general are responsible, there should be definite periods of invasion, given prevalence of disease in other countries, which synchronise with those of the migration of birds inwards. There are two migratory seasons, during both of which birds arrive in or leave this country. In the autumn certain birds leave to winter elsewhere. These can be disregarded as importers. Others arrive to winter in this country. These can probably be disregarded, as most of them come from the North where the disease seldom prevails. In the Spring months birds come in mainly from the South for breeding purposes, and might be carriers whilst others depart for the North.

In going back over the outbreaks in the period of 20 years, however, it appears that the lowest records of invasion are March—4, April—1, May—0; July, in which there is no migration, shows 8. September, October and November, when birds may be expected from the north and north-east, which are not the lands of prevalence as regards foot-and-mouth disease, show respectively 7, 7, and 4, while December, during which there is practically no migration inwards, shows 9.

These data are against the suggestion that there is any general relation between migration and invasion by foot-and-mouth disease. They do not, however, exclude the agency of those birds, such as ducks, geese and gulls, which may, outside the migratory seasons, travel long distances for food. For purposes of closer investigation it might be assumed :—(*a*) that such birds might in their travels frequent contaminated pastures or drinking places and afterwards deposit virus in this country from their feet or plumage; (*b*) That they might swallow infected material, such as water and food contaminated by slobber and pieces of membrane from the mouths of cattle, and afterwards excrete the virus in a still active state. It is hoped that experiments which are to be conducted on the viability of the virus may determine the possibilities as regards (*a*) and that as regards (*b*) feeding experiments with the virus, using birds, may at least show whether the virus can pass through their intestines unchanged, and render their excretions infective for lengthy periods.

As the matter stands at present, however, the evidence, such as it is, is most in favour of particles of virus being carried by the air.

THE MODERN COTTAGE OF CHALK AND CEMENT.

JOHN F. WILKES.

IN the September issue of this *Journal* an article was published describing experiments in cottage building in pisé de terre which are being conducted by the Ministry on its farm settlement at Amesbury. Among the illustrations which accompanied the article was one showing a cottage of chalk and cement blocks (made in a block machine) in course of erection. The following account of cottages built of the same materials at Elmdon, near Saffron Walden, some years ago may be of interest.

The photographs here reproduced were all taken in 1920. It will be noticed how well the stability and good appearance of the cottages have been preserved.

Fig. 1 illustrates a pair of cottages erected in 1904. The ground floor is built of chalk cement blocks, and the upper floor of lath and plaster on stud work; the chimneys only are of brick. The total cost of the two cottages was £356 9s. 8d. They contain 13,000 cubic feet, and the estimated saving of cost by using chalk blocks instead of bricks for the ground floor walls was £14 for the pair.

Fig. 2 illustrates a single cottage built in 1907 on similar lines, at a cost of £166, excluding outbuildings or fencing. The builder's original estimate was £187 for a brick cottage, but a saving of £21 was effected in respect of haulage, bricklayers' time, and the lower cost of blocks as compared with bricks at the time.

Fig. 3 illustrates a bailiff's house built in 1909. It is made entirely of chalk cement blocks, except for the chimneys. Twenty tons of cement were used at a cost of 16s. 6d. a ton at works; the cost of labour in making the blocks was £16 15s. The total cost of the house was £388, including cost of haulage of cement and bricks.

Fig. 4 shows a granary built in 1920 of chalk cement blocks made in 1919. The cost of chalk and cement blocks has increased considerably since 1904, as will be seen from the following table. The costs stated do not include the value of the chalk.

It will be noticed that in 1904 blocks were slightly larger than in 1919, and that the proportion of chalk to cement was

FIG. 1.—Pair of Cottages erected in 1904. Ground Floor built of Chalk and Cement Blocks, First Floor of Lath and Plaster.

FIG. 2.—Single Cottage erected in 1907, built on similar lines to Fig. 1.

FIG. 3.—Bailiff's House erected in 1909, built entirely, with exception of chimneys, of Chalk and Cement Blocks.

FIG. 4.—Granary erected in 1920, built of Chalk and Cement Blocks made in 1919.

4 to 1 as against 5 to 1 in 1919. During the last twelve months the cost of both cement and labour has risen considerably, even over the figure for 1919, and the present prices are quite beyond what the writer can afford from the income of the estate. The making of these blocks in this locality has in consequence ceased. Chalk and cement have, however, been used in repairing cottages originally built of lime mortar plaster.

Year.	*Size of Blocks.*	*Construction Ratio.*		*Cement per ton at Works.*
		Chalk.	*Cement.*	
1904	18 in. × 9 in. × 6 in.	4	1	25s. 6d.
1907	18 in. × 9 in. × 6 in.	4	1	16s. 6d.
1919	18 in. × 9 in. × 5½ in.	5	1	67s. 0d.

	Haulage 14 Miles.	*Total Cost per Ton.*
1904	5s. 6d.	31s. 0d.
1907	5s. 6d.	22s. 0d.
1919	12s. 0d.	79s. 0d.

	Labour per 100 Blocks.	*Cost of Cement per 100 Blocks.*	*Total Cost per 100.*
1904	12s. 6d.	17s. 1d.	29s. 7d.
1907	—	12s. 6d.	—
1919	21s. 0d.	39s. 6d.	60s. 6d.

Fig. 5 shows a cottage in which the original plaster has been entirely taken away at the ends, both inside and out, and rebuilt with chalk and cement without the use of any other material, such as hair or lime. This alteration was made in 1920. Previous work done on these lines has been found to answer well.

The blocks can be made by unskilled labour. The only material required in the way of plant is a few floor boards clamped together with wooden clamps, and wood partitions of the size of the end of the blocks. The process of manufacture is extremely simple. Chalk is run through a 1-inch sieve and mixed in a heap with cement and a little water. The whole is then well stirred with a shovel, and the mixture, in its damp state, is placed in moulds, and floated off with a trowel. When the mixture has set sufficiently, the clamps are taken off the moulds, and the blocks are then packed up to dry out. The drying takes about two or three weeks. The amount of water which should be added to the chalk and cement before the mixture is placed in moulds can be accurately gauged after a little experience. The mixture should be in a pliable state; if too much water is added, it takes longer to dry off, but otherwise no harm is done.

The blocks have always been made quite in the open. During frosty weather it is necessary to suspend operations, as the

water in the mixture would freeze, but wet weather is not harmful. The work is not heavy, and might suitably be performed by partly disabled ex-service men in districts where chalk is available. Such jobs could very easily be put out by piece work.

NOTE.—Mr. Wilkes' statement of comparative costs for blocks in the years 1904, 1907 and 1919 is very useful; but it should be noted that his proportions in the last year were 5 of chalk to 1 of cement, whereas for the chalk concrete block cottage at the Ministry's Farm Settlement at Amesbury the proportions were 12 of chalk to 1 of cement, or less than half the quantity of cement. The Amesbury Cottage, of which an illustration in course of construction was given in our September issue, and which is here shown completed (Fig. 6), has proved most satisfactory. Prices of both labour and cement have, however, risen since 1919. Mr. Wilkes used, roughly, 3/5 of a ton of cement in the proportion of 5 of chalk to 1 of cement to produce 100 blocks equivalent in size to 800 bricks. In the proportion of 12 to 1, as at Amesbury, 240 blocks would be produced with the same quantity of cement, equivalent to 1,920 bricks. Taking the present price of cement at 107s. 6d. per ton and the labour at 25s. per 100 bricks, the cement used would cost £3 4s. 6d., plus labour £3, to make 240 blocks. This works out approximately at an equivalent in bricks of £3 5s. 0d. per 1,000 as against a present average price for bricks of £5 per 1,000.

The other method of using chalk, adopted by the Department of Scientific and Industrial Research for one of their cottages at Amesbury, consisted of a mixture of chalk and cement in the proportion of 20 parts of chalk to 1 of cement. The mixture was lightly rammed between shutters, and has made excellent walling.

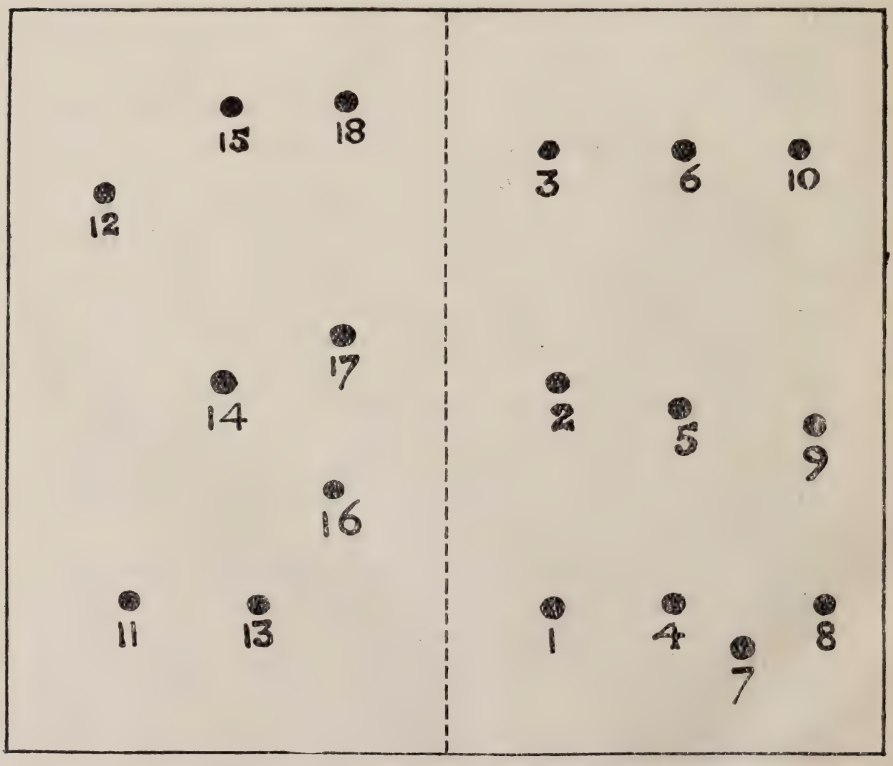
FIG. 5.—Cottage repaired outside and inside entirely with Chalk and Cement, without the aid of Hair or Lime.

FIG. 6.—Cottage on the Ministry's Estate at Amesbury, built of Chalk and Cement Blocks.

and of "bunted" ears.* The following table shows the results obtained :—

Table showing percentage of "Bunted" ears in a 32-acre field of Red Standard Wheat, Wye College Farm, 1918.

Position in Field.	*No. of Healthy Ears in the Sheaf.*	*No. of "Bunted" Ears in the Sheaf.*	*Percentage of "Bunted" Ears.*
1	1,380	375	21·4
2	1,180	107	8·3
3	753	77	9·3
4	1,080	150	12·2
5	1,265	212	14·4
6	1,330	127	8·8
7	1,405	275	16·4
8	1,290	160	11·0
9	1,694	132	7·2
10	1,095	252	18·7
11	1,520	25	1·6
12	1,385	40	2·8
13	1,294	6	0·5
14	1,230	23	1·8
15	1,216	20	1·6
16	1,428	17	1·2
17	1,287	16	1·2
18	1,007	43	4·1



B A

Plan of Field: Showing positions from which sheaves were taken.

*Mr. P. K. Dey, M.Sc. (who was then working in the Mycological Laboratory at Wye College) carried out this work, and the authors of the present paper wish to express their thanks to him for the help given.

It will be seen from the table that the severity of the attack of " bunt " in part A of the field varied from 7.2 per cent. to 21.4 per cent.—an average of 12.8 per cent., and in part B of the field from 0.5 per cent. to 4.1 per cent.—an average of 1.8 per cent. The cultivation and manuring of both parts of the field had been the same for the wheat crop, though the cropping had been different in 1917.* It would appear, therefore, that the greater severity of attack in part A of the field was due to some circumstances favourable for infection. Other cases are on record where wheat sown earlier in the autumn has been less severely attacked than similar seed sown later.

This severe natural outbreak of " bunt " provided us with excellent material for producing artificially severe outbreaks of " bunt " for experimental purposes. The " bunted " grains collected from the crop in 1918 were broken up and mixed with a certain amount of healthy seed from the same crop. After this admixture, the seed, as seen by the naked eye, was more or less discoloured, the end of the grain which bears a tuft of hairs being noticeably darkened. On microscopical examination, it could be seen that this discoloration was due to myriads of the " bunt " *spores* adhering to the surface of the grain, the tuft of hairs often being clogged with a dark mass of *spores*. Such artificially contaminated seed was used in the Field Experiments carried out in 1919 and 1920 which are described below. As will be seen, this seed, when sown without being treated, produced a crop very severely affected with " bunt," while treatment of the seed with certain substances killed the " bunt " *spores* adhering to the seed, which consequently produced a healthy crop.

Methods of Treating Wheat Seed.—The practice of treating wheat seed with a solution of copper sulphate (Bluestone)—an operation often called " pickling "—has been commonly adopted by farmers in this country for many years. The strength of the solution advocated for this purpose varies from one per cent. (1 lb. copper sulphate to 10 gal. water) to ten per cent. (10 lb. to 10 gal. water) and 1 gal. of the solution is used to the sack of wheat. In the writers' opinion, the solution used at this rate is insufficient to wet all the grains (clevils).

In the autumn of 1920 a sample of wheat (variety " Red Standard ") which had been pickled by a farmer in Kent with a 10 per cent. solution of copper sulphate, using 1 gal. to the sack, was sent together with an untreated sample of the same seed

* A had been cropped with potatoes, and B half with clover and half with sainfoin.

to the Ministry's Seed Testing Station for germination tests. The untreated sample germinated 98 per cent. in four days. The treated sample germinated only 47 per cent. in ten days; after 15 days it gave 57 per cent. and finally reached 60 per cent.

The extremely injurious effects, viz., the killing of a considerable percentage of the seeds and general retardation of the germination which is caused by a 10 per cent. solution of copper sulphate makes the latter, in the authors' opinion, far too dangerous a remedy for use against " bunt." This strength of solution, however, is at present commonly employed in England.* It is to be feared that many cases of a " poor plant " in wheat may have been caused by the seed having been " pickled " with too strong a solution of copper sulphate.

In preliminary germination tests carried out at Wye College it was found that a 10 per cent. solution of copper sulphate sprinkled over seed wheat so as to wet all the grains, reduced the vitality of the seeds to such an extent as to render the treatment impracticable. Solutions containing copper sulphate at concentrations of 5 per cent., 3.5 per cent., and 2.5 per cent. were then tried, samples being sent to the Ministry's Seed Testing Station for germination tests. The report received was as follows :—

Method of Treatment.	*Percentage of Germination.*
5 per cent. copper sulphate	80
3·5 " " " "	86
2·5 " " " "	88
Untreated	95

It was finally decided not to employ copper sulphate at a concentration higher than 2.5 per cent. in the experiments described below.

Another chemical substance, however, viz., formalin† possesses equally fungicidal properties against " bunt," and it is the object of this article to show that this substance, not at present used by farmers in this country for the prevention of " bunt," is well worthy of trial, since in the two years' field experiments described below, its use has been attended with satisfactory results.‡

* *e.g.*, in Kent, Sussex, Surrey, Berkshire and Herts.

† Formalin is the trade name for a 40 per cent. solution of the gas formaldehyde in water.

‡ In an article on the prevention of " Covered Smut " of barley (see this *Journal*, March, 1918, XXIV) the writers have shown that treatment of the seed with formalin gives complete protection against this disease, while the result of treatment with a 2·5 per cent. solution of copper sulphate was much inferior.

Field Experiments in 1919.—The seed used in these experiments was obtained from the crop of "Red Standard" wheat found to be severely attacked by "bunt" during the summer of 1918 (see p. 1013). Four samples of this wheat were taken; one sample was left untreated for the control plots and the others treated as follows:—

(1) *One per cent. Solution of Copper Sulphate.*—Commercial copper sulphate (98-99 per cent. purity) was dissolved in water,* so as to make a one per cent. solution (*i.e.*, at the rate of 1 lb. to 10 gal.) which was sprinkled over the seed and well stirred in until all the grains were wetted; the seed was then spread out to dry.

It was found that the volume of solution necessary to wet the grains thoroughly was 1 part to 16 parts of the seed, *i.e.*, at the rate of 1 gal. of the solution to 2 bush. of the wheat, and the solutions used in all the experiments described below have been applied at this rate.

(2) *Two and a half per cent. Copper Sulphate.*—This solution, prepared at the rate of $2\frac{1}{2}$ lb. copper sulphate in 10 gal. of water was applied in the same manner as the one per cent. solution.

(3) *Formalin* 1:240.—One part of formalin (40 per cent. formaldehyde) was added to 240 parts of water (*i.e.*, at the rate of 1 pint to 30 gal., or, for small quantities, 1 fluid oz. to $1\frac{1}{2}$ gal.) and stirred in until the formalin was uniformly distributed. The solution was then applied in the same manner as the copper sulphate solution, but instead of immediately spreading out the wetted corn to dry, it was placed in a heap and covered over with sacking which had been soaked in formalin solution of the same strength as that sprinkled over the corn. After four hours the wheat was uncovered and spread out to dry.

The seed was treated on 16th November, 1918, dried overnight, and on the following day the four samples were sown broadcast at the rate of about $3\frac{1}{2}$ bushels to the acre, on duplicated plots, each measuring 40 ft. by 10 ft. The plots were numbered as follows:—

Plots 1 and 5 seed treated with 1 per cent. copper sulphate.
„ 2 „ 6 „ „ „ 2·5 „ „ „ „
„ 3 „ 7 „ „ „ formalin 1:240.
„ 4 „ 8 „ untreated.

Samples of the treated and untreated seed were sent to the Seed Testing Station in order to have determined the effect of

* In dissolving copper sulphate in water, a wooden or earthenware receptacle must be used, not metal.

the treatment on the vitality of the seed. The report received was as follows :—

	Method of Treatment.	*Percentage of Germination.*
Sample 1	1 per cent. copper sulphate	94
.. 2	2·5 „ „ „ „	86
.. 3	Formalin 1:240	87
.. 4	Untreated	96

In August, 1919, plants were pulled from the centre of each plot, tied into a bundle and labelled according to the plot from which it was taken. From each bundle 100 ears were cut off at random; these were carefully examined and the " bunted " ears separated from the sound ones and counted. The results were so striking that it was decided to make duplicate countings for confirmation, so another bundle of plants was pulled from each plot, the plants in this instance being taken from the ends of the plots.

The results of the two series of countings were as follows :—

No of Plot.	*Seed Treatment.*	*Number of Bunted Ears in* 100. *From Centre of Plots.*	*From Ends of Plots.*
1	1 per cent. copper sulphate	17	15
2	2·5 „ „ „ „	3	1
3	Formalin 1:240	0	0
4	Untreated	49	71
5	1 per cent. copper sulphate	16	6
6	2·5 „ „ „ „	4	0
7	Formalin 1:240	0	0
8	Untreated	55	55

Combining these results for an estimate of the percentage of bunted ears according to the treatment the seed received, we obtain :—

Method of Treatment.	*Plot.*	*No. of Bunted Ears in* 200.	*No. of Bunted Ears in* 400.	*Percentage Bunted.*
Copper sulphate 1 per cent.	1	32	54	13·5
„ „ „ „	5	22		
Copper sulphate 2·5 per cent.	2	4	8	2·0
„ „ „ „	6	4		
Formalin 1:240	3	0	0	0
„ „	7	0		
Untreated	4	120	230	57·5
„	8	110		

Field Experiments in 1920.—In the following season another experiment was carried out in order to ascertain whether the results obtained in 1919 were confirmed by further trials, and also to determine whether a lower concentration of formalin

would be equally effective with the one already employed. For this experiment the seed from the plots grown in 1919 was collected and thoroughly mixed. Samples were taken and treated as in the previous season, together with a fifth sample that was treated with formalin at a concentration of 1 part in 320 parts of water (*i.e.*, at the rate of one pint to 40 gal. of water). Ten plots each 30 ft. by 14 ft. were marked out for the experiment so that each sample could be sown on duplicated plots.

As the total quantity of corn from the plots grown in 1919 was not great the threshing had been done by hand, and in consequence many of the " bunted " grains remained unbroken. These " bunted " grains were not separated out. The success of the sprinkling method of treatment as shown in the results given below, calls for remark since it is generally assumed that when such unbroken " bunted " grains are present in the corn, submersion of the seed in the fungicidal solution is necessary in order that the diseased grains may float to the surface and be skimmed off.

At the time of sowing, samples of the treated and untreated seed were again sent to the Seed Testing Station and the following report on germination was received:—

	Method of Treatment.	*Percentage of Germination.*
Sample 1	1 per cent. copper sulphate	96
„ 2	2·5 „ „ „ „	82
„ 3	Formalin 1:240	86
„ 4	„ 1:320	88
„ 5	Untreated	92

When the seedling wheat plants were a few inches high some difference in the vigour of the plants of the various plots could be detected, and in February, 1920, Mr. J. H. Mattinson examined the plots and reported on their condition (without knowing the history), as follows :—

Normal forward crop; best plant ... Plot 5 (One of the two control plots).

A thin rather weak plant ... ... Plots 3 and 8 (formalin 1 : 240).

The crops of the other plots were intermediate between the above and practically indistinguishable except Plot 9 (formalin 1 : 320) which though slightly better than Plots 3 and 8 was not so good as the rest.

These observations suggest that the formalin treatment has an adverse influence on the vigour of the seedling wheat plants, but further observations are necessary before definite conclusions

can be drawn on this point.* As the plants approached maturity the difference was not maintained, and when harvested the crops were equally vigorous apart from the plants infected with " bunt."

In August, 1920, bundles of plants were pulled from each plot and the number of " bunted " ears determined as in the previous year. Five bundles, however, were taken from each plot so that for each method of treatment 1,000 ears were examined. The results are shown in the table :—

Plot.	*Method of Treatment.*	*No. of Bunted Ears in* 500.	*No. of Bunted Ears in* 1000.	*Percentage Bunted.*
1	Copper sulphate 1 per cent.	29	71	7·1
6	" " " "	42		
2	Copper sulphate 2·5 per cent.	12	22	2·2
7	" " " "	10		
3	Formalin 1:240	0	2	0·2
8	" "	2		
4	Formalin 1:320	0	1	0·1
9	" "	1		
5	Untreated	117	319	31·9
10	"	202		

The only precautionary measures adopted at the time of sowing to prevent re-infection of the treated seed by spores from the untreated seed, consisted in sowing the former and raking it in before the latter was sown. Considering the fact that all the plots were sown on the same morning, and that the two formalin plots in which 1 and 2 " bunted " ears, respectively, were found, adjoined the control plots, the extremely low number of cases of infection on the formalin plots is remarkable. The results obtained show that the formalin treatment as employed in these experiments is completely effective in controlling " bunt " in wheat.

As the formalin treatment is not generally practised in this country the following notes on its use, based on the experiments recorded above, may be useful :—

(1) The diluted solution recommended for use is prepared by adding one part of formalin (40 per cent. formaldehyde) to 320 parts of water (*e.g.*, one pint formalin to 40 gal. of water, or, for small quantities, 1 fluid oz. to 2 gal.).

(2) This is slowly sprinkled over the seed wheat at the rate of 1 gal. of solution to 2 bushels of seed; the seed is moved about and stirred until the grains are thoroughly wetted.†

(3) The seed is then placed in a heap and covered with sacks

* Field Trials using formalin at lower concentrations are in progress.

† Under no circumstances must the solution be allowed to form pools under the heap in which grains might soak.

which have been soaked in the formalin solution; the sacks should be uniformly wet but not dripping.

(4) The treated seed is left covered up for 4 hours, then spread out to dry on a clean floor; if the floor has been previously used for untreated corn it should be wetted all over with the formalin solution and allowed to dry before the treated seed is spread on it.

(5) Precautions should be taken to prevent the re-infection of the treated seed, *e.g.*, sacks which have held untreated infected wheat should not be used for the treated seed, unless they have undergone treatment by being soaked in the formalin solution or boiled in water.

Summary.—1. There is reason to believe that the common practice of " pickling " seed wheat with a 10 per cent. solution of copper sulphate (1 lb. to 1 gal. water) as a preventive against " bunt " results in serious damage to the germination of the seed.*

2. Experiments carried out at Wye College on wheat of the " Red Standard " variety grown on duplicate plots during two seasons have shown that:—

(*a*) Formalin 1 : 240 solution or 1 pint to 30 gal. water, when sprinkled over the seed, which is then covered by sacks soaked in the same solution for 4 hours before being spread out to dry, completely controls " bunt " in wheat.

(*b*) A 2.5 per cent. solution of copper sulphate (2½ lb. to 10 gal. water) reduces the amount of infection considerably but is less effective than the formalin solution.

(*c*) A 1 per cent. solution of copper sulphate (1 lb. copper sulphate to 10 gal. water) also reduces the amount of infection, but is far less effective than either the formalin solution or the 2.5 per cent. solution of copper sulphate.

3. Formalin, 1 : 320 solution or 1 pint to 40 gal. water, has proved to be as effective in controlling the disease as the stronger (1 : 240) solution, and is therefore to be preferred.

4. The quantity of solution necessary to wet thoroughly 4 bushels (a sack) of wheat has been found to be 2 gal.

5. The formalin solutions at the above strengths and also the 2.5 per cent. solution of copper sulphate show a tendency to reduce slightly the percentage of germinating seeds, so that treated seed should be sown a little thicker than normal.

* For this reason the Ministry of Agriculture in its Leaflet No. 92 recommend a weaker solution even though it is known that with this solution the control of bunt is not so complete.—*Editor Journal.*

RECENT RESEARCH IN EGG PRODUCTION.

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THE following account aims at giving, in a summarized form, a description of some of the results obtained by research work in egg production. Abroad, especially in America, a considerable amount of work has been done and much more is in progress. The results of this research work are often applicable to animal production in this country, and the short summary here given of some of the conclusions arrived at may therefore be of interest to those concerned in production.

Much of the research work which is alluded to below needs confirmation, as some of the experiments have only been carried out on a small scale, and many of the facts elucidated in other countries require investigation here before it can be definitely ascertained whether they hold good in our climate. A large number, however, are of universal application, and some of the discoveries mentioned below, such as the mode of inheritance of high egg production, have already been taken advantage of in this country.

Inheritance of High Production.—Extensive investigations have been made in the United States by Raymond Pearl(1) and other workers on the production of eggs, and many useful discoveries have been made. Probably the most important is that the power of high production of eggs in the hen is inherited mainly through the cock. Pullets that are bred from a cock of high-producing strain mated with hens of a moderate-producing strain will lay many more eggs than will pullets which have been bred from a cock of moderate-producing strain mated with hens of a high-producing strain. Pearl's investigations were made with the Plymouth Rock and Cornish Indian Game breeds, and in view of their great importance it is desirable that they should be repeated with the breeds and strains of fowls kept in England. Indeed, it seems of the utmost importance, if any advance is to be made in the average yield of eggs, that the inheritance of fecundity in English breeds should be tested. Goodale(2) found that in the Rhode Island Red high egg production was inherited, but not in the manner observed by

(1) *Jour. Exp. Zoology*, 1912, p. 153.
(2) *Jour. Agr. Res.*, Vol. 12, 1918, No. 9.

Pearl. Pearl found also that the difference between a high-producing and a low-producing hen did not depend on the number of oocytes in the ovary, but on the number which developed, and that this quality was inherited in the fowl. He further discovered that the best measure of the capacity of a hen to produce eggs was the number of eggs produced during the winter months; hens which laid well at that time produced the greatest number of eggs in the year.

Selection of Hens.—Several investigators have given attention to the problem of the early identification of a high-producing hen, so that the unproductive layers may be weeded out with a minimum of delay. Blakslee and Warner[3] found that when birds with yellow pigmented skin, ear-lobes, beak and legs (as in Leghorns, Plymouth Rocks and Wyandottes), begin to lay, the yellow colour disappears from the ear-lobes, beak and vent, in the order named, probably being transferred to the yolk of the egg. When laying stops the colour is regained in the same order. This result was taken as a test for the unproductive hen, and it is found that the greater the amount of yellow colour in the ear-lobe the less active is the laying.

Chard[4] has found that the high producers of one year continue to be the high producers during the second year, and that all the birds selected for high production during the months of November, December and January gave high records for the whole year.

Ball and Alder[4a] also found that the more eggs hens produced in the year the greater was the proportion laid during the winter period; so that the breeding and keeping of hens of high productivity has the double advantage, in that not only are more eggs produced, but that they are produced at a time of scarcity and so command good prices. Wilson[5] has discovered that a hen's total yield for the year can be predicted from her performance during the first eight or ten weeks of the laying season (November, December and January). Good layers produce during this period as many as five eggs per week, while bad hens yield few, if any.

Chard[4] also noticed that the production of eggs was closely dependent on the temperature, and this is probably the underlying cause of the variations in productivity that exist at

(3) *Utah Sta. Bul.*, 1917.
(4) *Connecticut Storrs Sta. Bul.*, 1917.
(4a) *Jour. Amer. Assn. Instr. and Invest. Poultry Husbandry*, No. 5, 1917.
(5) *Jour. Dept. Agr. and Tech. Instr. for Ireland*, Vol. 14, p. 271.

different times of the year. The causes of these variations require to be carefully analysed. Temperature may be only one of the factors influencing this point; there may be others, such as differences of light and darkness, or the amount of green food available, which cause increased production during the spring months.

Research is required as to the effect of a rise of temperature on the egg production of fowls which have become used to a low temperature, to determine whether it is the change of temperature or the actual temperature which causes increased production of eggs in the spring months.

Variation with Time of Year.—Numerous investigators have recorded the variations in productivity that occur as a result of the time of year. The following table summarizes some of the results obtained :—

Average Egg Yield per Bird per Month.

Authority.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Pearl (6) (U.S.A.)	11·71	10·87	16·11	15·85	13·92	12·46	10·87	9·84	*	*	4·63	8·91
Buckley (7) (England)	5·50	7·91	13·97	13·23	12·90	9·70	8·01	6·33	5·30	3·70	3·60	5·46
Irish Egg Records (7a)	6.3	9·3	15·9	15·8	14·9	11·5	10·1	8·3	6·0	3·9	2·4	4·0

* No data.

Simpson(8) in Edinburgh found that the highest egg production took place in April and May. Data collected by the author of this paper show that in Norfolk the highest production is reached in March and April. This monthly variation in production is probably due to variations in temperature, as in Australia(9) the highest egg production is reached in the months of September and October, which correspond to our months of March and April.

Economically this monthly variation in production is important, as it governs the price of eggs, which bears an inverse ratio to the number produced. The curve of the rise and fall in price follows and lags slightly behind the curve of production.(10) It follows that the most successful poultry keeper is

(6) *The Canadian Thresherman and Farmer*, Vol. XX,, No. 2, 1915.
(7) "*Farm Records and the Production of Clean Milk at Moundsmere*," London, 1917.
(7a) *Dept. Agr. and Tech. Instr. for Ireland*, Vol. 13, p. 366.
(8) *Proc. Roy. Soc. of Edinburgh*, Feb., 1912.
(9) *Queensland Agricultural Journal*, N.S. Vol. I., 1915.
(10) *Maine Sta. Bul.* 105, 1908.

he who manages his flock so as to produce eggs when they are scarce. In this connection it may be emphasised that the high-producing hen lays a greater proportion of eggs at those times when eggs are scarce.

Attempts have been made to modify this variation in production due to time of year by obtaining pullets hatched at certain seasons of the year.

Elford[11] in Canada found that, in both Leghorns and Plymouth Rocks, early hatched pullets laid the most eggs in the year, and consequently a greater proportion in the months when eggs were scarce. Buckley[7] in England, who experimented with several breeds, obtained the following results:—

	February Pullets.	March Pullets.	April Pullets.	May Pullets.	Hens of previous Year.
No. of eggs laid between October and March ..	64	62	48	39	39

Buss[12] in America found that White Leghorn pullets hatched in different months of the year produced the following average number of eggs per annum:—

February hatched.	April hatched.	June hatched.
167.	156.	144.

Variation with Age of Hen.—Buckley[7] found that hens did not produce so well as pullets which had been hatched in time. Ball, Alder and Egbert[13] have studied this point in a flock of White Leghorns over a period of eight years; the average egg production per hen for each year of life from their investigations was as follows:—

Years of Life.	1	2	3	4	5	6	7	8
No. of eggs laid per year (approximately) ..	130	120	110	85	75	65	55	45

In the Copenhagen[14] egg-laying trials it was found that the older hens, as compared with the younger, lay a smaller percentage of their eggs during the winter months, when eggs are most valuable.

Rhythm of Egg Production.—It has been noticed by several investigators that egg-laying takes place in cycles (*i.e.*, periods of consecutive egg-laying at the rate of one egg per day) and

(11) *Canada Expt. Farms Rept.*, 1915.
(12) *Monthly Bul. Ohio Sta.*, No. 3, 1919.
(13) *Utah Sta. Bul.*, 1916.
(14) *84th Rept. Royal Vet. and Agri. Col.*, Copenhagen, 1914.

that there is a definite rhythm in the recurrence of these cycles.

Patterson[15], who investigated this rhythm, has attempted to apply it to the selection of the highest producing hens. He found that hens which had a cycle of 4 eggs or more in March produced on the average 156 eggs per year, whereas hens having a cycle of 2 eggs or less averaged only 110 eggs in the year.

It is interesting to note that Atwood and Weakley[16] discovered that the first egg laid in the cycle is usually the heaviest, and that the eggs decrease in weight until the cycle has ended.

Broodiness.—A probable cause of the lowering of the productivity is the onset of broodiness. This is largely a breed characteristic. Kirkpatrick and Card[17], who investigated this point, found that the percentage of broody hens in the various breeds was as follows :—

White Leghorn, 9·7 per cent.; Rhode Island Reds, 65·6 per cent.; and Wyandottes, 69·6 per cent. They calculated that the average number of days lost by each broody hen in the year was 53.

Goodale[18] estimated that broodiness reduces a hen's production by about 40 per cent.

In this connection it is suggestive that Pearl and Boring[19] have discovered in the ovaries of fowls certain bodies which they consider resemble the *corpora lutea* of mammals.

Pearl and Surface[20] found that they could inhibit egg-laying in a fowl by giving doses of the *corpora lutea* of cows. These authors, however, disagree with Clark[21], who claimed to increase the egg production of fowls by administering pituitary substance with the feed.

In the Copenhagen[14] laying trials it was noticed that within any one breed broodiness was more pronounced in the best layers. As this result appears to conflict with the investigations of Goodale and the fact that "sitting" breeds are frequently better winter layers, it would appear that further research is required as to the effect of broodiness on egg production. It may be that some relation may exist between

(15) *Jour. Amer. Ass. Instr. and Invest. Poultry Husbandry*, Nos. 2 and 3, 1916.
(16) *West Virginia Sta. Bul.*, 1917.
(17) *Connecticut Storrs Sta. Bul.*, 1917.
(18) *Massachusetts Sta. Rept.*, 1915.
(19) *Amer. Jour. of Anatomy*, No. 1, 1918.
(20) *Jour. Biol. Chemistry*, No. 2, 1914.
(21) *Jour. Biol. Chemistry*, No. 3, 1915.

broodiness and the period occupied in moulting, but on these points, so far as the writer is aware, no research has been made.

Goodale[22] has shown that individuals of a breed show considerable variation in broodiness, and that the tendency to go broody increases with age. Broodiness is also dependant on the time of year and the temperature, but no effective methods of preventing it have yet been found.

Research on the effect of broodiness on egg yield and the physiological causes of the broody condition would appear to afford promising results.

Breed Variation.—Numerous breed trials and tests have taken place in most countries, but only a few need be quoted here.

Three-year tests made at Copenhagen[14] show the following order of merit of breeds as regards production of eggs:—Leghorns 100, Plymouth Rocks 70, White Wyandottes 60.

Lewis[23] quotes tests in the United States to show that the average number of eggs laid per bird per year was approximately as follows:—Leghorns 170, Plymouth Rocks 155, Rhode Island Reds 150, Wyandottes 144.

Laurie[24] in South Australia found that the average yearly egg production per bird in the various breeds was as follows :— White Leghorn 199, Orpingtons 170, Wyandottes 170.

It is possible, however, that English strains of these breeds would not hold the same relative positions as regards fecundity.

The Irish winter egg record tests[25] (October to March) for the seven years 1908-1915 show the following averages for the different breeds :—White Leghorns 49·5, Rhode Island Reds 45·9, White Wyandottes 35·8, Plymouth Rocks 32·9.

These records also show, however, that there is much greater variation in the different strains of a breed than there is between breeds; thus the best pen of White Leghorns averaged (October to March) 84 eggs, while the worst averaged 31 eggs, and the best pen of Plymouth Rocks averaged 55 eggs, while the worst averaged only 15 eggs. Within any breed there appears to be much room for improvement along the lines of inheritance of high egg production through the cock, as has been demonstrated by Pearl.[1]

Ball and Alder[4a] have shown that breeds differ in the time of year at which the highest rate of egg production takes place.

(22) *Anat. Rec.*, No. 6, 1917.
(23) *New Jersey Sta., Hints to Poultrymen*, No. 4, 1918.
(24) *Bul. Int. Inst. Agr., Rome*, II., 1914, p. 1400.
(25) *Dept. Agr. and Tech. Instr. for Ireland*, Vol. 15, No. 3, 1914-1915, p. 592.

They compared White Leghorns with general purposes breeds, and found that the latter reached their maximum rate of production early in the season and then rapidly fell off to moderate production, whereas the White Leghorns reached their maximum production a month or so later, but continued to produce heavily for several months, and then fell off rapidly towards the end. Experiments in this country are required before these conclusions can be accepted as applicable to our climatic conditions; it may be possible to alter the time of year of greatest productivity by providing shelter and other conditions which would modify the natural tendency of the White Leghorn to attain its maximum production later in the spring than the " sitting " breeds.

The Copenhagen trials[14] showed that Plymouth Rocks laid more eggs than Leghorns during the winter months. At first sight this might seem to contradict the statement made above, that high-producing hens lay more eggs in the winter months, but it possibly may be due to the fact that Plymouth Rocks go broody and so reduce the summer yield (see " Broodiness " above, p. 1026).

Effect of Egg Production on Body Weight of Hen.—The effect of high egg production on the body weight of the hen was studied at the Copenhagen trials, and it was found that, although the weight of the birds increased with age up to the end of the second year, yet within each year the weight of the hen's body undergoes certain variations. Increase in weight takes place from the autumn to the spring, and then during the spring and summer the weight decreases. This seasonal change in weight was especially noticeable in good layers.

Kirkpatrick and Card[17] also found that hens were heaviest on 1st March, before the period of maximum egg production, and lightest on 1st May, after the period of maximum production. In this connection the observations of Wieninger[26] are interesting; he found that within any one breed the best layers had the lowest body weight. Thus, in a flock of Golden Wyandottes he noticed that the best layers averaged 2·4 kilos in weight, whereas the worst layers averaged 2·6 kilos. In the Italian Partridge breed the best averaged 2·1 kilos and the worst 2·4 kilos (a kilogram is 2 1-5th lb.).

Attempts have been made at the Harper Adams College[27] to discover some relationship between the shape of the bird

(26) *Wiener Landw. Ztg.*, No. 26, 1912.
(27) *Utility Poultry Journal*, Harper Adams College, No. 12, 1917–18.

and the number of eggs laid. The distance from the hind end of the keel to the pelvic bones was thought to be the best guide to laying capacity.

Effect of Exercise.—In America experiments have been made to compare the egg production of fowls allowed free range with those in confinement. Buss[28] found that exercise increased the production of eggs, and similar results were obtained by Kirkpatrick and Warner.[29] The latter put up two pens of White Leghorns, each of 40 birds; the first pen was confined and the second had the run of a yard. The following table shows the number of eggs laid by the two pens:—

Weeks of Experiment.	1st—13th.	14th—26th.	27th—39th.	40th—52nd.	Total for Year.
Confined	179	1,221	1,589	1,483	4,472
Run in Yard	466	1,285	2,079	1,525	5,355

Size of the Egg.—The size of the egg laid by the hen is undoubtedly a breed characteristic. It was found in the trials at Copenhagen[14] that the average weight of eggs was greater in the Minorcas and Leghorns than in the Wyandottes and Houdans. Kirkpatrick and Card[30] found that the average weight of twelve eggs of various breeds was as follows:—Rhode Island Reds 1·60 lb., Plymouth Rocks 1·58 lb., Leghorns 1·50 lb., and Wyandottes 1·48 lb.

Murphy[31] in Ireland, who investigated the inheritance of the size of eggs, found that, when a hen laying a large sized egg was mated with a cock, the son of a similar hen, the pullet offspring invariably laid eggs of large size. In America, also,[32] it has been shown that ability to lay large, heavy eggs is inherited.

The size of the eggs laid by any hen, however, varies with the time of year. Atwood[33] discovered that the eggs are heaviest from November to April and lightest from May to October; thus a pen of hens in February laid eggs which averaged 12·72 lb. per 100 eggs, whereas the same pen in June was laying eggs which averaged only 11·07 lb. per 100 eggs. A possible explanation of this fact is suggested by Warner

(28) *Ohio Sta. Bul.*, 1916.
(29) *Pennsylvania Sta. Rept.*, 1914.
(30) *Connecticut Sta. Bul.*, 1915.
(31) *Dept. Agr. and Tech. Instr., Ireland, Jour.*, No. 2, 1917.
(32) *Bul. Rhode Island State College*, No. 4, 1918.
(33) *West Virginia Univ. Agri. Exp. Sta. Bul.* No. 145, 1914.

and Kirkpatrick,[34] who noticed that small eggs were laid at a time when the hen is laying most heavily. Brown,[35] however, found with White Leghorns that there is nothing to indicate that high production is responsible for any diminution in the size of the egg, and Murphy[31] found that small eggs were not always coupled with heavy production.

In the Copenhagen trials[14] it was observed that the weight of the egg appeared to increase with the age of the hen, and it is a matter of common observation that pullets lay smaller eggs than do mature hens. It has been pointed out above that the first egg laid in the cycle is usually the heaviest.

Colour of the Egg.—Very little is known concerning the causes which influence the colour of the egg shell. Tinted egg shells are supposed to be due to products of hepatic origin (bile pigments) secreted by certain glands of the oviduct.

Laurie[36] found in Australia that the tinting was less marked in warm weather. Tinted shells, however, are undoubtedly chiefly a matter of breeding, although Lewis and Thompson[37] in America have observed that some hens produce eggs varying widely in colour, while others show a marked uniformity in this respect.

The colour of the yolk is no doubt greatly influenced by the food of the hen; thus Henriques and Hansen[38] found that hens fed on grains gave a light yellow yolk while grass and herbs produced a dark yellow yolk, and a diet of worms gave yolks of a reddish hue. Opperman[39] in America, who experimented with lots of forty White Leghorns, found that feeding on yellow maize produced a rather deep yellow, while wheat meal gave a very pale yolk. Hink,[40] who fed acorns to fowls, noticed that they produced yolk of a dirty brown colour.

From these experiments and from those quoted above on the effect of egg production in reducing the yellow colour of the legs and ear-lobes in certain breeds, it would appear that the colouring matter of the yolk of the egg is derived from the colouring matter of the fat of the body. The colouring of the body fat is in turn derived mainly from the green colouring

(34) *Jour. Heredity*, No. 3, 1916.
(35) *Jour. Bd. of Agric. and Fisheries*, No. 3, 1916.
(36) *Jour. Dept. Agric.*, S. Australia, Nos. 9—10, 1915.
(37) *New Jersey Sta. Rept.*, 1915.
(38) *Skandin. Archi. f. Physiol.*, Vol. XIV., 1905.
(39) *Country Gentleman*, No. 9, 1914.
(40) *Deutsche Landwirt. Tierzucht*, No. 29, 1915.

matter of plants, much in the same way that the colour of butter fat is produced.

Fertility of Eggs.—It has been found in pigeons that the presence of the male stimulates egg production in the female, but experiments on a small scale with fowls have shown very little effect. Nelson(41) kept two pens of 10 hens each for a year, one pen with a cock and the other without; the yearly average egg yield per hen in the former was 126, and in the latter 118. There were no differences in the keeping qualities of the eggs from each pen.

Numerous investigators have observed the time that elapses, after the cock has been put with the hens, before the first fertile egg is laid. In the trials at Copenhagen(14) it was found that the first fertile eggs were produced three or four days after mating.

Observations have also been made as to the time a hen remains fertile after the cock is removed from the pen. Chappellier(42) found it to be 10 to 18 days. Elford(43) states that a drop in fertility of the eggs occurs on the sixth day after removal of the cock, while at the tenth day only 50 per cent. of the eggs are fertile, by the nineteenth day only 16 per cent. are fertile, and thereafter all are infertile. Philips(44) observed that no fertile eggs were laid after the fifteenth day from the last mating. Kaupp(45) concluded from his experiments that it is not advisable to save for hatching eggs laid five days after the cock has been removed. He also states that if hens have been running with a mongrel cock and are required for pure breeding it would be safe to mate them eighteen days after the mongrel cock has been removed. *i.e.*, fertility is considerably reduced after five days, but a number of eggs remain fertile up to the eighteenth day.

In-breeding.—No extensive investigations on the effect of in-breeding on the fertility of the eggs have been made. Gray and Kaupp(46) found that when daughters were bred to their sires the fertility of the eggs was only slightly reduced, but the hatchability of the eggs was affected to the extent of 10 to 30 per cent. Indeed, as in-breeding is so often used by poultry keepers to fix characters, and as cross-breeding is so

(41) *New Jersey Sta. Rept.*, 1906.
(42) *Compt. Rend., Ass. Franc. Adv. Sci.*, 1914.
(43) *Canada Exp. Farms Report*, 1916.
(44) *Jour. Amer. Ass. Instr. and Invest. Poultry Husbandry*, No. 4 1918
(45) *North Carolina Exp. Sta. Bul.*, 1915.
(46) *North Carolina Station Report*, 1917.

frequently resorted to by commercial poultrymen in order to increase the vigour of the strain, it is remarkable that practically no experiments have been made to determine the effect of in-breeding and crossing on the fecundity, fertility and size of the bird. Research on these lines might lead to valuable conclusions.

Elimination of Cockerels.—Punnett[47] has shown that breeders may eliminate at once all cocks from their hatch of chicks and rear only pullets, provided certain colour crosses are made. By mating hens of some breeds with cocks of a different colour the male chicks can be picked out as soon as they are hatched and disposed of, thus ensuring that all accommodation is available for rearing pullets. If a black cock is used with barred Plymouth Rock hens, all the male chicks are barred and all the females are black. The male barred chicks can then easily be identified at hatching by the white patches of down on the head and rump.

A silver coloured hen transmits silver to her sons and gold to her daughters in the same way. Silver and Gold Laced Wyandottes are examples of this, as also are breeds such as Light Dorkings (silver) when crossed with Brown Leghorns (gold).

In conclusion it must be emphasized that many of the observations and experiments quoted above have been made only on a small scale and that many, before they are generally accepted, should be repeated under the conditions existing in this country.

(47) *Journal Bd. of Agric.*. Vol. XXV., Feb., 1919.

A SHELL FACTORY: FOR POULTRY.

The fame of the English oyster is at least as old as the Roman Empire; it found an honoured place at Imperial banquets. Juvenal, in his Fourth Satire, writes of the Roman glutton who could "discriminate with nicety at the first taste whether the oysters were Circean natives or bred on the Lucrine rocks or from the Richborough (Rutupiae) beds." Through the centuries intervening, the popularity of the oyster has never waned and to this day such entertainments as the Oyster Feast, celebrated annually at Colchester, are attended by some of the most admiring and eloquent lovers of shell-fish. In these circumstances, a threat to the oyster fisheries of Colne and Blackwater and elsewhere is a threat not only to a thriving industry but to the continuity of a great tradition, and it is an unfortunate fact that the oyster has found a deadly enemy, though one that does not seek deliberately to treat the victim either as a foe or as a source of food. The Slipper Limpet (*Crepidula fornicata*) lives side by side with the oyster, sometimes even attaching itself to the oyster shell, and competes with it for the food supply. Unfortunately too, it multiplies more rapidly than the oyster, to which it bears a relation similar to that between weeds and a neglected crop. Where the limpet does attach itself to the oyster shell—this happens only in a minority of cases—the injury is direct. In the presence of such an unwelcome guest the oyster is quite unable to pivot upon its axis and feed in the conventional fashion of its kind, so it has no choice but to die uncomfortably in its bed. A few years ago the mortality from all causes was growing so steadily that (in 1916) a big effort was made to deal with the problem. At West Mersea, in the centre of the Colchester oyster fisheries district, an old barn was set apart as a factory and, under the direction of Dr. H. L. Jameson of the Ministry of Agriculture and Fisheries, a spirited attempt was made to save the threatened industry. A drying machine and a crushing machine were installed, and fishermen who saw their means of livelihood diminishing steadily as the slipper limpet extended its ravages, were invited to enter upon new activities and dredge for their enemy instead of their friend.

To-day they carry the catch to an uninhabited spit between Tollesbury and West Mersea, where it remains for six months, by the end of which time nothing is left but shell. The shells are then brought in wagons to a dump outside the barn whence they are carried to a point where, by means of a series of buckets

on an endless chain, they are passed through a furnace which takes the last particles of moisture away and leaves them in a completely inoffensive condition. From the furnace they are conveyed to a disintegrator which grinds them into three sizes, coarse, medium and fine, each being received into separate sacks. This ground shell may be used for poultry instead of oyster shell, which is so much more difficult to procure and so much more expensive; it has a similar lime content. The demand is considerable and grows steadily, so that an increase of output is indicated. The drying furnace is an emergency machine, obtained in 1916, but it cannot keep pace with the more modern crushing plant, consequently a new drying machine is to be installed. This will be capable of handling about 4 tons of limpet shells per hour, and these in their turn will produce 3 tons of finished product. The present crushing installation is capable of handling 10 tons a day while the furnace cannot yield more than 6.

It is interesting to learn that the whole plant, which can treat the shells collected by 30 or 40 fishermen, and employs about a dozen workers in the handling, is entirely self-supporting, and under the rather restricted conditions that obtain at present, is turning out annually over a thousand tons of crushed shell for poultry. With the increase of plant, the output will be increased very considerably, and there is unfortunately no likelihood of the industry coming to an end because slipper limpets multiply rapidly. Only as the result of years of strenuous dredging is it likely that the oyster grounds will be able to maintain themselves.

There is one other side to the industry at West Mersea which calls for passing comment. Quite apart from the shell for poultry, there is a very important by-product, of which a visitor to the factory can hardly fail to take note. This is a fine powder, from which nobody working in the neighbourhood appears to be quite free. The dust is 66 per cent. pure lime and is of the greatest value on sour ground. At present there is a very high mound of it, a mound that increases day by day, but unfortunately the cost of transport renders marketing impossible.

Perhaps the most interesting aspect of the whole business is that it provides an instance of a pest bringing about the creation of a profitable industry, which enables those who have been hard hit by a trouble to turn that trouble to account.

PROFITABLE EGG PRODUCTION: HIGH PRODUCTIVITY ESSENTIAL.

THAT the most important factor in profitable egg production is high productivity is exemplified by the experience of a member of the Ministry's staff. The original birds of the small flock were Wyandottes, obtained from one of the Incubating Stations which were first established by the Ministry of Agriculture in 1915. One of the objects of these stations is, by distributing stocks of high laying capacity, to encourage poultry keepers to eliminate the unproductive barn door fowl from their flocks.

Of six birds comprising the original pen, three were sold on 15th September last. Five pullets, the sire of which was a Wyandotte cock of the same strain as the earlier birds, were raised during the year. These came into lay at the middle of August. The standard daily ration of each bird during the year was 4 oz. of concentrated food, composed of 2½ oz. mixed grain (wheat, oats and maize) and 1½ oz. meal (bran, middlings and fish meal) in varying proportions. The meal was used for drying off a warm mash of household scraps. In addition, a small supply of green food was provided.

The following Profit and Loss Account covers the period of the year ended 15th November last; it includes the cost of rearing the five pullets mentioned above:—

DR. PROFIT AND LOSS ACCOUNT. CR.

	£	s.	d.		£	s.	d.
1,556 eggs, valued at wholesale prices ...	30	8	5	Cost of Live Stock and Equipment (cash)	18	4	3
Stock sold (cash) ...	2	5	0	Cost of Food (cash) ...	11	5	0
Equipment in hand at end of year, valued at cost, less 20 per cent. depreciation...	7	0	0	PROFIT	17	19	2
Live stock in hand at end of year, valued at market prices (3 hens, 5 pullets, 1 cock)	7	15	0				
TOTAL	£47	8	5	TOTAL	£47	8	5

An analysis of the accounts yields some interesting information. For instance, the average daily cost of food of each bird was 1d., while the average value of one egg (at wholesale prices) credited was 4.7d. Each egg cost 1.7 in food to produce, and each hen of the original stock laid an average of 232 eggs during the year. Two hens were off laying for a period of six weeks

while rearing chicks, but no deduction has been made on this account. The aggregate number of hen-days (including pullets in lay) was 2,470. Including the pullets, therefore, the average number of eggs laid per bird per day was 0.6, equivalent to 18 per month. Again, the cost of food for each laying hen for the year was £1 10s. 6d. By writing off at the end of the year the sum of 5s. for depreciation in the value of the bird, 5s. for depreciation in the value of the equipment, and 3s. for part cost of the cock, the total cost of keeping each laying hen was £2 3s. 6d. As each hen of the original stock laid 232 eggs during the year, realising the sum of £4 10s. 10d., the net profit per laying hen may be estimated as £2 7s. 4d.

A profit could not be shown, however, unless the hens were of high laying capacity. For instance, if, instead of each hen laying 232 eggs during the year, it had laid only 110 eggs the profit of £2 7s. 4d. per hen would have disappeared.

This enforces the point that it is the object of this note to bring out, namely, that high productivity is essential to profitable egg production, and high productivity can only be obtained by keeping stock of high laying capacity.

SYNTHETIC NITROGENOUS FERTILISERS.

E. J. Russell, D.Sc., F.R.S.,
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A synthetic substance is one that is prepared from its elements; synthetic nitrogenous fertilisers, therefore, are those produced in the factory from their elementary constituents instead of being obtained as by-products of some manufacturing process, as is the case with sulphate of ammonia.

So far as the farmer is concerned it is quite immaterial how the fertiliser is made so long as it contains no harmful ingredients, and his chief interest is to obtain adequate supplies at as low a cost as possible. The name " synthetic " is therefore of manufacturing interest but of no agricultural consequence.

It so happens that the fertilisers which the manufacturers find it easiest to make are rather different from those now obtainable. It would be quite easy to manufacture nitrate of soda in the factory, and the product would have the same fertiliser value as the natural nitrate imported from Chili, but it is rather easier for the manufacturer to prepare nitrate of lime; hence this course is adopted. Similarly, sulphate of ammonia could be prepared synthetically without much difficulty; it is, however, easier to make chloride of ammonia, and it is likely, therefore, that this fertiliser will be produced. Each of these fertilisers, in addition to giving increases in crops, has some special property which may be of value to the farmer, while the widening of the sources of supply is of course of considerable importance at the present time.

The question of making synthetic fertilisers was first opened by the late Sir William Crookes in 1898 in an address to the British Association, which at once caused a great deal of discussion. Sir William pointed out that the population was increasing more rapidly than the area under wheat, and consequently a time must come when wheat supplies would be insufficient unless the production per acre could be raised.

In order to meet this contingency he proposed that the supply of nitrogenous fertilisers should be increased so as to ensure progressive increases in crop yields. He further pointed out methods by which nitrates could be made artificially. This principle was carried into practice at Notodden in Norway and subsequently at Niagara, where factories were erected and considerable amounts of nitrates produced. For purposes of convenience nitrate of lime was made, although, as already stated, nitrate of soda could equally well have been produced, but at greater expense.

The process requires considerable power, and the great advantage possessed by Norway and Niagara, where cheap water power is obtainable, is therefore evident.

The second process, requiring somewhat less power, gives rise to calcium cyanamide or nitrolim. This was first made at Piano d'Orte in Italy, and is now produced at Odda in Norway, Alby in Sweden, at Niagara and elsewhere.

Had the fertiliser problem alone been involved nitrate of lime and nitrolim would probably have been the only fertilisers produced synthetically, and their manufacture would have been confined to places where cheap water power was available. Just before the War, however, it was found that ammonium nitrate could be used as a high explosive of very great power, and the German chemists proceeded to devise methods whereby it could be easily obtained in quantity from the air. A satisfactory method was developed by Haber for producing ammonia from the air, and a second process was worked out by Ostwald for converting this into nitrate. The necessary factory developments were made, and by the middle of 1914 the process was working on a large scale at the Badische Anilin Fabrik, Ludwigshafen. The War naturally caused remarkable developments in all the belligerent countries, and in consequence the technical difficulties have been very largely overcome. As a result the manufacturer is now able to prepare the following substances, the nitrogen in each case being derived from the air :—

Nitrate of Lime,	Chloride of Ammonia,
Nitrate of Ammonia,	Calcium Cyanamide, or Nitrolim,
	Urea.

Nitrate of Lime.—This substance has been manufactured in Norway since 1907, and has formed the subject of many fertiliser trials in this country and abroad. An idea of the rapidity with which its use was spreading before the War is

obtained from the following figures showing the quantities exported from Norway:—

Exports of Nitrate of Lime from Norway: Metric Tons per Annum.

1907	...	...	...	1,344
1908	...	...	...	7,053
1909	...	...	...	9,422
1910	...	...	...	13,531
1911	...	...	...	9,805
1912	...	...	...	51,701
1913	...	...	...	70,927
1914	...	...	...	75,176

During the War great modifications took place, and the exports fell to nearly one half of the 1914 figure:—

1915	...	...	...	38,609
1916	...	...	...	46,001
1917	...	...	...	35,921

This was partly due to the diversion of acid to the manufacture of ammonium nitrate, and partly to a rise in the home consumption; before the War Norwegian farmers used only 6,000 or 7,000 tons of nitrogenous fertilisers per annum, whereas in 1917 they used 20,000 tons, and the estimated quantity for 1918 was 55,000 to 60,000 tons. The Norwegian Company, the "Norskhydro," has, however, allowed for expansion, and there is no reason to fear any failure of supplies.

Experiments show that nitrate of lime comes nearer to nitrate of soda than any other fertiliser. Like nitrate of soda it is rapid in action, easily soluble, improves the colour and appearance of crops, and induces quick growth. It differs from nitrate of soda in four respects:—

1. It contains no soda, which on some soils is a useful fertiliser for grass and mangolds.
2. It contains calcium, which is often of value in improving the vigour of plants.
3. It is very soluble in water, and in some cases may prove too soluble, so that there may be difficulty in handling; this problem, however, was being studied before the War, and the difficulty is now probably overcome.
4. It does not "poach" heavy soil, and can therefore be used without damage to the texture.

On balance there is probably not much to be said for the differences, although in individual cases some of them may assume importance. On the whole, nitrate of lime has usually proved as effective a fertiliser as nitrate of soda, sometimes the

one and sometimes the other giving the better results. The following are the results of some experiments:—

Mangolds.

	Midland Agric. Coll., 1915. (1)				Gloucester. (2) (3)						Reading, 1909. (4)	
	Light soil.		Heavy soil.		1909.		1910.		Chalk soil.		Strong loam.	
	t.	*cwt.*	*t.*	*cwt.*	*t.*	*cwt.*	*t.*	*cwt.*	*t.*	*cwt.*	*t.*	*cwt.*
Nitrate of soda ..	29	8½	30	14	29	14	32	4	25	11	34	18
Nitrate of lime ..	28	8	30	4½	32	5	30	3	25	11	35	1
No nitrogenous top dressing ..	20	10	25	18½	23	14	28	0	21	19	28	3

1.—Harper Adams Agric. Coll. Repts. 1909 and 1910, p. 33.
2.—Glos. Repts. 1909 and 1910, p. 74. Table I.
3.—Royal Agric. Coll. Repts. Cirencester 1910, p. 31.
4.—Reading Univ. Coll. Dept. Agric. 1909. Bull. vii. p. 11.

	Potatoes.						Barley.		Wheat.	
	Woburn, 1909. Sandy loam. (1)		Devon. Light soil. (2)		Jersey. (5 centres) (3)	Aberdeen. various centres, 1907–9. (4)	Rothamsted, 1909.		Rothamsted, 1910.	
							Grain.	Straw.	Grain.	Straw
	t.	*cwt.*	*t.*	*cwt.*	*lb. per perch*	*t.* *cwt.*	*bush.*	*lb.*	*bush.*	*lb.*
Nitrate of soda..	15	9	10	15	221	9 5	48·1	3882	27·0	3760
Nitrate of lime..	15	6	10	7	228	9 6	46·2	4449	20·7	3618
No nitrogenous top dressing	14	12	9	18	195	8 6	28·7	2619	15·4	1526

1.—J. Roy. Agric. Soc. 1909, p. 385.
2.—Devon C. C. Rept., 1907-9, p. 6.
3.—State of Jersey Field Expts. 1911, p. 2.
4.—Aberdeen and N. Scotland Coll. Leaflet 9, p. 2.

It is interesting to note that these results agree substantially with those obtained in Germany and Austria. In order to avoid the use of foreign measures the results are calculated to an average value of 100 for nitrate of soda:—

	Rye.	Wheat.	Barley.	Oats.	Potatoes.	Sugar beet.	Mangolds.	Average of all.
Nitrate of soda ..	100	—	100	100	100	100	100	100
Nitrate of lime ..	97	105	110	109	102	97	73	99

These results show that a farmer will be fairly safe in regarding nitrate of soda and nitrate of lime as equally effective per unit of nitrogen, but he must be prepared to find differences which are smoothed out in the above average results, but which may operate on his farm.

Unfortunately for buyers, nitrate of soda and nitrate of lime do not contain equal amounts of nitrogen, so that a direct comparison of price is misleading; comparison can be made only by calculating the price of 1 per cent. of nitrogen in each case. As a rule nitrate of soda contains 15½ per cent. of nitrogen and nitrate of lime 13 per cent.

Nitrate of Ammonia.—Nitrate of ammonia is essentially a wartime product. The Norwegian exports were, in metric tons, per annum:—

1910	—
1911	3,024
1912	4,270
1913	9,107
1914	11,959
1915	26,459
1916	59,639
1917	63,578

The German production is estimated as follows, in metric tons:—

1912	—
1913	20,000
1914	40,000
1915	100,000
1916	200,000
1917	333,000

The figures for 1916 and 1917 lack confirmation, but they were undoubtedly high.

There was also a considerable production in this country, but it was from pre-existing nitrogen compounds, so that the material could not be described as synthetic. The Nitrogen Products Committee of the Munitions Inventions Department* carried out experiments during the War, as the result of which a factory was started at Bellingham: since the War this factory has been taken over by a private company. Large quantities of ammonia will be produced and then converted into a suitable salt. Ammonium nitrate presents no technical difficulties, and could easily be prepared in sufficient quantity to satisfy any agricultural demand. In peace time it can be used as fertiliser; should, unhappily, another war break out it can be used as explosive.

Numerous experiments have been made with ammonium nitrate as a fertiliser. It has proved to be very quick in action, and well suited to horticulturists, market gardeners and others using large amounts of nitrogenous manure and desiring speedy effects. It is also effective on the farm. Comparison has not always been made with the same substance; sometimes nitrate of soda has been used as the standard, and sometimes—as at

* A note on the Report of this Committee was published in this *Journal*, February, 1920, p. 1112.

Rothamsted during the War—sulphate of ammonia. Some of the results are:—

—	Aberdeen.					Newton Rigg.	
	Hay, cwt. per acre.			Oats, lb. of grain per acre.		Mangolds, tons per acre.	
	1911-14. General Average.	1913. 3 centres.	1914. 3 centres.	1911.	1914.	1913.	1914.
Nitrate of Soda ..	53·8	69·2	57·8	2644	2280	20¾	23¾
Nitrate of ammonia	56·2	69·7	59·9	2787	2427	14¾	21½
No nitrogenous top dressing	50·2	65·7	58·4	2477	1853	—	—

—	Mangolds.	Rothamsted, 1918.				
		Potatoes.	Wheat.			
			Expt. 1.		Expt. 2.	
	t. per ac.	*cwt. per ac.*	Grain. *bush.*	Straw. *lb.*	Grain. *bush.*	Straw. *lb.*
Sulphate of ammonia	18·6	175·4	41·3	5250	40·1	4830
Nitrate of ammonia	23·3	174·5	44·7	5070	37·7	5050
No nitrogenous top dressing ..	17·3	160·9	38·6	4588	34·6	4520

In the Aberdeen experiments the ammonium nitrate was somewhat better than nitrate of soda, while at Newton Rigg it was inferior in action; in the latter case the soda may have had some specific effect. At Rothamsted the ammonium nitrate was better than the sulphate for mangolds, although judging by the character of the haulm it was less suitable for potatoes and might have given less crop had there been disease. It is much more concentrated than sulphate of ammonia or nitrate of soda, containing as a rule about 34.8 per cent. of nitrogen, of which one half is in the form of ammonia and one half nitrate. It must therefore be used sparingly—only ½ cwt., or even less, should be applied—and there may be difficulty in ensuring that these quantities are not exceeded. This matter, however, is within the farmers' control.

Another and more serious difficulty is that ammonium nitrate tends to become wet and form a hard cake, which, however, is readily broken with a wooden mallet. Some kinds used to become very damp, but technical chemists learnt a good deal during the War and found ways of mitigating this disadvantage. The factor that will finally determine whether ammonium nitrate remains on the market as a fertiliser is the cost. If nitrate of soda is obtainable at £20 per ton, nitrate of ammonia is worth

about £37 5s.; and unless it can be produced at this figure it is not likely to command an extensive sale.

Ammonium Carbonate.—It would not be a difficult matter to prepare ammonium carbonate synthetically, and as a fertiliser it would have the advantage that it could not cause soil acidity, while it would be at least as effective as sulphate of ammonia. Samples have already been prepared: one sent to the Rothamsted laboratories contained 25.5 per cent. of nitrogen and another contained 18.4 per cent. Ordinary sulphate of ammonia contains about 20 per cent. Unfortunately, however, the material is very volatile and rapidly loses ammonia, and until this difficulty can be overcome it offers little prospect to the farmer.

Ammonium Chloride.—From the financial point of view the most promising synthetic ammonium salt is the chloride, which is likely to be turned out in great quantity in this country in the near future. In the past it has been practically untested by British investigators; the large production of sulphate of ammonia appeared to rule out any possibility of the manufacture of the chloride. For many years it was used at Rothamsted in conjunction with sulphate of ammonia, but no careful comparison between the two salts was made.

On general grounds it might be supposed that the chloride and sulphate of ammonia must be of equal fertiliser value. There is, however, much physiological evidence to the effect that chloride under certain conditions may be harmful to plant growth. It by no means follows that this would happen in practice; whether it would or not can only be ascertained by trial. In view of the technical importance of the salt, an extended investigation is to be made.

Urea.—During the War several patents were taken out in Germany for the manufacture of urea as a fertiliser. Urea has the advantage of being highly concentrated, containing no less than 47 per cent. of nitrogen, an enormous advantage for the export trade. Whether it would have equal advantages for the home trade is not so clear. A field experiment is being carried out this year at Rothamsted.

Cyanamide or Nitrolim.—This substance is already well known as a fertiliser, although during the War it was not readily obtainable by farmers. The growth of its manufacture

was very rapid before the War, the number of metric tons produced in the different countries being, in total:—

1906	500
1907	1,700
1908	2,510
1909	11,550
1910	20,495
1911	54,506
1912	104,938
1913	156,944

During the War the expansion in producing capacity of the various works was astonishing:—

1914	194,726
1915	771,155
1916	981,500

Most of the expansion took place in Germany. Arrangements are now being made for the establishment of works in this country.

It is usual to compare nitrolim with sulphate of ammonia. The broad result of all the trials is that nitrolim is somewhat slower in action than the sulphate, and is better drilled with the seed than used as a top dressing. Taking successes and failures together, the value of the nitrogen in nitrolim can be expressed as 90 if that in nitrate of soda is expressed as 100: sulphate of ammonia comes in between at 96.6. Some of the failures, however, doubtless arose from improper use, and it is quite probable that a better average will be made in the post-war period. Experimental results obtained at Rothamsted and elsewhere show how some of the failures arose. A certain poisonous impurity may be present, which, however, the technical chemists can no doubt avoid, and a certain preliminary decomposition has to take place in the soil, the effective agent for which may not always be present. The fault lies not so much in the material as in our defective knowledge of the proper conditions for using it; fortunately, this is a matter that can be put right. Those concerned in this country fully realise these difficulties and will no doubt find a way out.

Among many experimental results, the following may be quoted:—

	Potatoes.							
	Woburn, 1909. Sandy Loam.		Devon. Light Soil.		Jersey. (Five Centres).	Aberdeen. (Various Centres) 1907-9.	
	t.	*cwt.*	*t.*	*cwt.*	*lb. per perch.*	*t.*	*cwt.*
Sulphate of ammonia ..	15	19	12	0	228	9	12
Nitrolim	15	7	12	0	232	8	17
No nitrogenous fertiliser ..	14	12	9	18	195	8	6

	Mangolds.		Barley.		Wheat.	
	Reading.		Rothamsted, 1909.		Rothamsted, 1910.	
	Strong Loam.		Grain.	Straw.	Grain.	Straw.
	tons.	*cwt.*	*bush.*	*lb.*	*bush.*	*lb.*
Sulphate of ammonia ..	33	1	49.1	3517	24.6	2964
Nitrolim	33	3	45.2	3976	22.4	2343
No nitrogenous fertiliser ..	28	3	28.7	2619	15.4	1526

The results are better than those reported from Germany and Austria; putting the nitrogen in nitrate of soda at 100 the values for sulphate of ammonia and nitrolim are:—

	Rye.	Wheat.	Barley.	Oats.	Potatoes.	Sugar beet.	Mangolds.	Average of all.
Sulphate of ammonia	93	54	89	97	94	95	68	84
Nitrolim	74	87	75	79	78	66	72	76

There are, however, some abnormal results here; allowing for these the German authorities, in framing their " monopoly law " of 1915, fixed the following value:—

Nitrogen in nitrate	100
„ ammonia	91
„ nitrolim	83

In this country we should give higher values to ammonia and nitrolim, setting them at 96 and 90 respectively.

The composition of nitrolim has varied slightly since it was first introduced. In the raw state it contains 19.5 per cent. to 20.5 per cent. of nitrogen, which makes it suitable for chemical works, but not for farmers. It contains carbide that needs to be decomposed by water, and dust that has to be fixed by oil. These processes bring down the nitrogen first to 18.5 per cent. and then to 15 or 16 per cent.; just before the War a modification in the granulating process brought it down to 14.5 or 15 per cent.

PIT, TRENCH, AND OTHER IMPROVISED SILOS*

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THE ensilage system in farming seems to be rapidly increasing in popularity in this country. The chief obstacle to its further extension appears to be the very high cost of concrete or wooden silos, and it is desirable, therefore, that all other methods should be considered which would involve a smaller outlay of capital and would give satisfactory results.

Pit Silos.—In previous issues of this *Journal*† attention has been drawn to the making of silage in "trenches." The term "trenches" has been used to describe rectangular holes, 3 or 4 ft. deep, as distinguished from the cylindrical "pits" of about 20 ft. or so in depth and 12 to 16 ft. in diameter, used in America. Deep pit silos can only be used where both soil and sub-soil are very dry, so that there is no fear that water may have access. Silos of this nature were excavated some years ago by Mr. H. C. Boggis, of Wrentham, Suffolk, on his farms at Easton Bavents, near Southwold. There is not always sufficient green material available to fill the silo, however, since the land at Easton is very light and subject to drought, and Mr. Boggis keeps on his arable land a flock of sheep, which in a dry May and June require all the green food he can grow. When filling this pit silo the green material is simply chaffed and allowed to fall into the pit, until the latter is full. Galvanised iron is arranged round the pit to a height of 6 ft. to enable the green stuff to be heaped above the ground, since the material sinks when allowed to settle. The silage is removed from the pit by means of a hoist.

In America, where this type of silo is quite common, the inside of the pit is often lined with cement. The best way to construct such a silo is to excavate a circular hole of the required diameter a few feet deep, line the side with cement, and then continue excavating and cementing until the required depth is reached. The bottom of the pit may also be lined

* A paper read at the Agricultural Organisers Committee of the Agriculture Education Association held at Cambridge, July 1920.

† "A Simple Method of Making Silage,' July, 1919, p. 450; and "Preserving Green Fodder—An Inexpensive Trench Silo," April, 1920, p. 65.

FIG. 1.—Showing home-made Elevator, with endless chain and slats.

FIG. 2.—Fodder for Ensilage in growing stage.

with cement, but this is not necessary if the soil is very dry. A layer of cement one inch thick on the inside is found to be sufficient; it is not even essential to line the sides at all. In order to lift the soil from the pit, and later, when the silo has been filled, to remove the silage, a hoist or rough wooden crate, with pulley attached, is erected near the mouth of the pit.

The advantage of this type of silo is that it is inexpensive. There is, however, some danger that human beings or animals may fall into the pit unless a curb of concrete is made 3 ft. or so high around the margin. Where the pit is deep there is also danger of poisonous gases accumulating at the bottom, with the risk of suffocation to the men who descend to remove the silage. A lighted lantern lowered into the pit, however, will serve to indicate whether any poisonous gases are present. If the light goes out it is dangerous to descend, and the air should be agitated to allow a current of pure air to pass to the bottom of the pit. The labour of removing the silage from the pit is not considered to be greater than that involved in elevating the raw material in the case of cylindrical tower silos. The pit silo on Mr. Boggis' farm at Easton is not lined with cement, but is merely a cylindrical excavation of a diameter of about 18 ft. and a depth of 12 ft. Such a pit would obviously fill with water if dug in any but dry soil. There are, however, in this country many sites where soil and sub-soil are very dry, or which are situated near slopes where there is no possibility of water accumulating and where this type of silo might be used. The green material used should be chaffed, and where this is done the silage made in the pit is quite good. Mr. Boggis fed the silage made in his silo to sheep and cattle quite successfully.

Unused Silos.—There are a number of silos in various parts of the country which were erected 30 or 40 years ago and have fallen into disuse. A farmer who may be fortunate enough to have such a silo on his farm may easily use it to make silage according to modern methods. These old silos are usually rectangular in shape, and not very deep. If, however, they are filled with chaffed green material and the contents are subsequently weighted, excellent silage may be made in them. Such a silo existing on the farm of Mr. Kindred, Pound Farm, Gt. Glemham, was recently filled with a mixture of second crop meadow grass and maize—material which would otherwise have been wasted. This mixture made excellent silage.

Silos made from Old Barns and other disused Farm Buildings.—Quite a number of silos of this type exist, and any farmer having a disused barn or similar building can usually adapt it for use as a silo by the exercise of a little ingenuity.

Figure 1 shows such a barn in use on Mr. Boggis' farm at Wrentham. In this case the walls of the barn were lined with cement, the corners rounded off internally, and one portion partitioned off from the rest of the barn. Short wooden planks fitted in the partition serve to close up the doorway. These wooden planks are removed one by one as the silage level is lowered during the winter. The portion of the barn separated off in this way is 18 ft. high, and the internal dimensions of the floor are 18 ft. by 16 ft. The silage is elevated into the barn through the opening shown in the illustration.

An ordinary chaff cutter, placed on a platform and driven by a tractor, is used. The material is lifted to the barn by means of an elevator of a slanting length of 20 ft., constructed according to Mr. Boggis' suggestions by a local firm. Fixed to the elevator is an endless chain of the type used on binders, with slats fixed at intervals of 2 ft., to carry up the chaffed green material. This elevator cost £16 at pre-war prices, but as it was a new design a second one could probably have been made for a smaller sum. It was found necessary to affix a special bonnet to the chaff cutter, as the ordinary bonnet did not clear the green stuff satisfactorily.

Trench Silos.—In view of the very high price of cylindrical tower silos, whether of the wooden stave or concrete type, it has been thought desirable to investigate further the system of making silage in trenches, so successfully practised by Mr. Wm. Makens, of Colney, Norwich. As previously mentioned in this *Journal** the three trenches used by Mr. Makens vary in size, the largest being 25 yd. long, 4 ft. deep and 5 yd. wide. By the courtesy of Mr. Makens the writer was able to visit Colney when this trench was being filled in June, 1920. It is estimated that the trench will hold about 400 loads of green stuff.

After the heap of green stuff in the trench is well topped up, Mr. Makens covers it up with earth. In winter, when the silage is needed, the earth is removed, and the material is cut out in sections as is done with hay, and is loaded into a cart for conveyance to the stock. The silage is fed in its long state.

* July, 1919, p. 450.

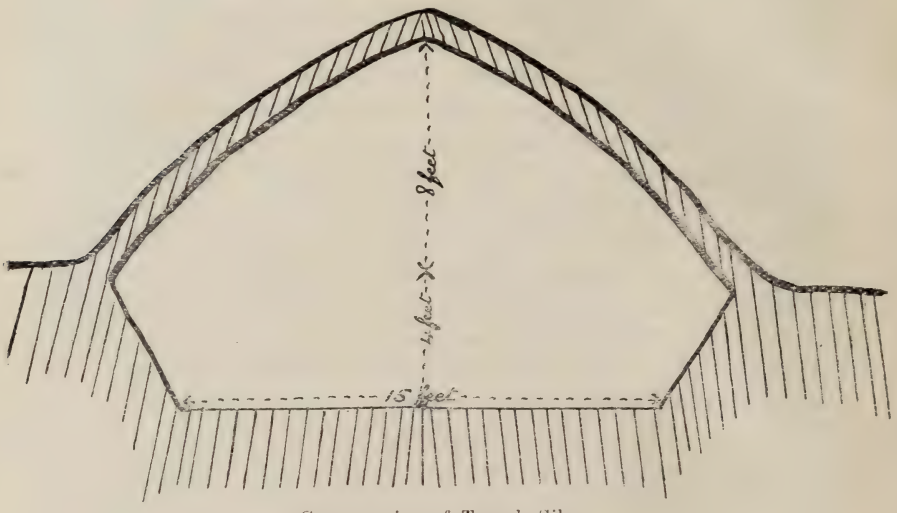
In 1920, Mr. Makens filled the trenches with a mixture of oats and tares and rye and tares. When these crops were examined it was found that the tares had almost smothered out the oats, and that the whole crop was lying flat on the ground, causing some trouble in cutting it. On the other hand the rye and tares mixture stood up fairly well, the whole crop being about 3 ft. 6 in. high. The mixture which proved the more successful was half a bushel of rye and two bushels of winter tares per acre.

There can be no doubt that rye sometimes gets old and woody when sown mixed with tares, but this difficulty can be obviated by cutting the crop in good time—say the third week in June. Early cutting has also the advantage that the land is cleared earlier, and more time is allowed for a bastard fallow, or for ploughing for turnips. There appears every reason to suppose also that as tares become more mature, the proportion of indigestible fibre present in them increases. This is a point, however, which requiries investigation. Captain W. A. Doran, formerly of Harristown House, Ardee, states that he made silage of a crop of beans during the summer of 1919, and fed it to the stock in winter with excellent results. This silage was made in a trench, according to Mr. Makens' method and proved most palatable to the cows. There was, however, a certain amount of waste on the sides and top. Inquiry from another farmer who made silage in this way confirms the writer's opinion that the amount of waste depends to a considerable extent on the care with which the heap is roofed up. Unless a good steep roof is made, rain gains access at the top, and rotting ensues. Everyone with a knowledge of farming knows the way in which a hay stack roof will sink, and the roof of a heap of silage sinks much more. It also seems likely that a rough thatch arranged outside the earth roof to keep out some of the winter's rain would be an advantage and would result in less rotting on the top.

The writer is indebted to the Ministry of Agriculture for calling his attention to a letter from Mr. N. A. Gatenby, of Jemolong, Blackheath, New South Wales, in the issue of the *Pastoral Review* for April last. Mr. Gatenby writes:—

"When I first made silage in 1890, I knew only of stacks, and made one with great care—it turned out a hopeless failure . . . . The next year I made another, with much the same result. . . . . The making in pits is simplicity itself; nothing can be simpler or easier. It is almost impossible

to avoid making good silage. . . . . The sides of the pit were almost perpendicular; the slopes at each end about 1 in 6. This allowed the green stuff to be carted in at one end, and the teams to go out at the other. The long roadway slopes also allow the ensilage to be conveniently carted out. Each succeeding load is carted in and thrown off, the carts passing over the previous loads, and giving the necessary pressure required to exclude air. When the pit is full the stuff can be arched up 6 or 8 ft., the carts going over in the same way.



Cross section of Trench Silo.

Then leave a few days, when it will be found the height will be perhaps 3 or 4 ft. less, through settling down; then build up again, and scoop earth on top, say 2 ft. deep; plough a furrow round to carry off influx of water, and you have first-class ensilage, good for 20 years to come. If the pit bottom is clay, I should advise a shaft a few feet deep, to carry off any extra soakage. I used one layer of saplings along the flat bottom, but as the soil was loamy right through, I doubt if even this was necessary.

"The above seems simple enough, and I never used a thermometer, and have only a hazy idea as to sweet, sour, acid, sub-acid ensilage; what I do know is that, wherever exhibited—Royal Show, or elsewhere—the silage so made has nearly always taken first prize.

"I have often been asked if heavy rain falling as a pit is being filled is harmful, and I have never found it so. I know

of 3 in. causing no appreciable difference in the subsequent silage; moreover, the greenstuff can always be thrown in wet with dew or rain."

Mr. Gatenby's experience appears to be identical in most respects with that of a number of farmers in this country. It is not suggested that the method of making silage in pits or trenches results in material of the same high quality as that made in cylindrical tower silos, but there is no doubt that thoroughly good silage can easily be made in this way. There is much in this method which should commend itself to the very large class of farmers in this country whose capital is limited and who do not care to invest £400 in a tower silo.

RAT DESTRUCTION BY GOVERNMENT AID.

E. C. READ,
Technical Adviser to the Rats' Branch of the Ministry of Agriculture and Fisheries.

THE damage done by rats to the national food supply, to property and to Public health is a matter of the first importance to the community, and within the last two years the question of repressive measures has been brought home to the country by the Ministry's active propaganda. Much has been done to educate the Public conscience. Instruction has gone hand-in-hand with practical methods of extermination conducted on scientific lines. National Rat Weeks, periods of special effort, have had the most encouraging results, both in regard to the number of rats killed, and in the stimulation of Public interest. It may be claimed that the general Public is at last realising the urgency of dealing with the rat problem, and although much still remains to be done.

Statutory repression of vermin did not originate in 20th Century progressive legislation. In the reigns of Henry VIII and Elizabeth, Statutes enjoining the destruction of rats, mice and even insects were in force. The Account Books of Wardens and Overseers bear witness to payments made out of local funds, primarily ecclesiastical, for such destruction, and these entries continued down to the middle of the 19th Century. As recently as twenty years ago the Local Government Board authorised the payment of rewards for the destruction of rats during an outbreak of *plague* in East Suffolk, and in 1909 a Rats Destruction Bill was presented to Parliament by Sir Charles Maclaren. The Bill was dropped before the second reading, but a few years later the course of events brought the question before the nation in so urgent a form that legislation could be postponed no longer. In 1918, when the German submarine menace had forced this country to augment its supplies of home-grown food, it was realised that the storage of foodstuffs brought about an alarming development in the rat population. This increase in rats meant an enormous increase in the damage done to stores—a fact that no national economist could afford to neglect. Consequently, the Ministry of Food issued the Rats Order, 1918, and the Ministry of Agriculture undertook the administration of that measure with the co-operation of Local Authorities. The next step was the formation of the Rats' Branch of the Ministry on 15th January, 1919.

Two months later an Order amending the Rats Order, 1918, was issued permitting Local Authorities to delegate powers to various minor bodies.

It was found that the permissive powers given to Local Authorities under the Rats Orders did not make for any very general or energetic grappling with the problem, and it became manifest that some wider measure would be necessary.

A noteworthy proof of the growing interest in rat destruction was given by the Royal Sanitary Institute at its Congress held in July, 1919, at Newcastle. The Congress passed the following resolution :—

> " That the Council of the Royal Sanitary Institute be recommended to urge upon the Ministry of Health the necessity of continuing as a health measure the powers conferred under the Rats Order, and that support be given to the Bill dealing with rat destruction now before Parliament."

Before the end of the year, public feeling had become so much alive to the importance of rat destruction that in December, 1919, the Rats and Mice (Destruction) Act was passed almost without opposition. Strengthened by legal sanction, the Ministry embarked on a policy of combined action on organised lines.

In order to stimulate public action, a pamphlet (D.R.2.) was issued, urging the institution of Rat Weeks. Between October, 1919, and March, 1920, three such periods of special effort were held. The Army Authorities co-operated, the Press gave most friendly assistance, cinematograph managers helped to advertise the scheme, and Rat Clubs and Boy Scouts lent a hand. The value of concerted action within a given area was shown by the estimated returns of rats killed. In many districts the number exceeded 100,000. The following are some results from districts where help was given by the Ministry during 1919. In the county of Southampton 121,500 rats were destroyed between 24th March and 18th June. Throughout the year the county of Hertfordshire showed a record of 235,739 rats destroyed, and in five months Leicester reported a " kill " of 125,223. During six months' operations in Buckinghamshire 22,341 rats were killed: during seven months in Oxfordshire 52,000; during six months in Shropshire, 64,485; and during two months in Staffordshire 62,074. On suggestions made by the Ministry a systematic campaign was organised throughout the country by the Military Authorities. The Military Supply Reserve Depot at Deptford—an area 40 acres in extent—was treated successfully

on lines suggested by the Ministry's Technical Adviser. Further, 7,500 copies of the pamphlet for the guidance of Rat Officers were distributed by the Army Medical Department to all Medical Officers.

During the first National Rat Week 60,000 sets of premises were treated at Bristol, and it is estimated that 200,000 rats were killed. The year 1919 saw excellent progress in acquiring knowledge of devices for rat destruction. The Ministry and the Local Government Board co-operated in an exhibition held at the Royal Zoological Society's Gardens; 300 tests were made to determine the best and safest raticides and it was found that the media suggested by the Ministry, namely, Carbonate of Barium and Red Squill, were not only the cheapest but the most effective. At the instigation of the Ministry almost all makers of proprietary poisons agreed to supply Local Authorities at prices much below their usual rates. The Rats' Branch encouraged the importation of the necessary raw materials, and gave recipes to manufacturers and the public generally, thus enabling them to prepare baits at very low prices. The Rats' Branch was further able to show that the employment of sugar as a means of attracting rats is not essential.

With the additional powers obtained under the Rats and Mice (Destruction) Act, 1919, great progress has been made during 1920 in organising the carrying out of systematic methods of destruction throughout the country.

Not only Government Departments but public bodies—scientific, social, industrial and commercial—are showing an increasing interest in the question of rat destruction. Very clear evidence of this interest was given at the Royal Sanitary Institute's Congress at Birmingham, where the announcement of a special conference on rat destruction drew an audience too large to be accommodated in the hall set apart for the meeting. Papers were read by several experts, including Dr. W. M. Willoughby, Medical Officer to the Port of London, Surgeon-Commander McKeown, and on behalf of Professor Zuschlag. The ensuing discussion brought out many valuable points of interest and information. At the Sanitary Inspectors' Association Conference at Margate the question was earnestly discussed at a special meeting, and at the Conference of Port Sanitary Authorities steps were taken to ensure a properly co-ordinated inspection and fumigation of vessels in port.

At Kew Gardens, which are under the Ministry's supervision, rats had done great damage to valuable wild fowl and had eaten their eggs. In July the Ministry's officials visited the Gardens,

ascertained the extent of the depredations, traced the principal rat runs and laid baits. These precautions have proved most beneficial.

The results of the National Rat Week held on the first six days of November, 1920, were altogether encouraging. The experience of former Rat Weeks had indicated the most suitable methods of giving instruction and of advertising the scheme, and these were again put in force vigorously. The general results are not yet known. Precise statistics of the numbers of rats killed cannot unfortunately ever be obtained, but there is every reason to believe that the "kill" far exceeded that of previous special campaigns.

Some statistics of the work of 1920 can, however, be given. During the month of January 120,000 rats were destroyed in Monmouth, and 140,000 in Somerset. After the fumigation of a ship on arrival at the port of London 1,466 dead rats were picked up—a sufficient testimony to the menace which rat-infested vessels present to the country. In Dover 16,000 rats were killed and 18,000 caught on bird lime during twelve months. On Foulness Island 7,000 rats were killed during six months, and in the same place the Ministry's Technical Adviser and his assistants, acting on behalf of the Army Authorities who own the Island, cleared the rats from the sea walls. In Gloucester 356 parishes were treated during January of last year, with a consequent very effective clearance. The London and North Western Railway Company have appointed an officer to superintend destructive work over the whole of their system. This official has had the advice of the Ministry's Technical Adviser. Part of his work has been the treatment of the Birmingham area, which he did at a cost of £9. It is instructive to note in this connection that last year treatment of the same area by virus cost the Company £217. Of one hundred railway stations treated as the Ministry's experts directed, 96 were successfully cleared and 2 partially cleared, while 2 attempts unfortunately proved failures. The causes of failure were, however, investigated; the treatment was repeated, and the result was a complete success.

This review can give only a brief account of what has been accomplished in less than two years. Although progress is undeniably remarkable, much more remains to be done to reduce the rat population to such small dimensions that neither the health nor the wealth of the community shall suffer longer from this pest.

IMPROVEMENT OF GRASS LAND:

THE IMPORTANCE OF EXPERIMENTS.*

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IT should be clearly understood that the campaign for the improvement of grass land instituted by the Ministry does not aim at converting arable into pasture land. The object is so to improve existing pastures and any new pastures which must be laid down, either temporarily or permanently, that with the desired extension of the arable area, the amount of grass will at least not be diminished but will even be increased. It is therefore intended that the improvement should not be limited to obviously poor old pastures, but should extend to all classes of grass land which are capable of improvement by any method.

The Value of Experiments.—Our present information with regard to pastures is very largely based upon results obtained by means of experiments in various parts of the country. The conditions under which these have been carried out vary a great deal, and one can never be quite sure that if an experiment which has been carried out in one part of the country is repeated in another part, where the conditions are more or less different, the results obtained will be exactly similar. This, however, does not mean that such experiments are of but little value. They have proved to be of great value in many cases, and have already led to a very great improvement, and results obtained in one district have been reproduced in other distant localities.

Manuring for Meadow Hay.—Methods of manuring for meadow hay vary considerably, and many are based on very long practice. This, however, does not prove that they are the best possible. It may be that an improved method would produce either greater quantity, or better quality, or, what is chiefly to be aimed at, an improvement in both quantity and quality.

The case of water meadows is obviously one where a great deal of information might be obtained by means of well-conducted experiments. At the present time farmers are faced with the difficulty of cost, both of upkeep and of haymaking, and a system, therefore, which would reduce expenditure and at the same time

* Abstract of a lecture delivered by Mr. T. J. Jenkin at a meeting of the Farmers' Union at Dorchester, 25th September, 1920.

improve the quality of the herbage and maintain or even improve the quantity (where desired) would be most useful. There are cases where it has been found possible to widen the "panes" in water meadows without any ill-effect. Other farmers have found it profitable to go farther, to abandon the method of manuring solely by means of well-regulated flooding, and to rely upon the use of artificial manures, especially basic slag.

In other cases, farmyard manure is chiefly or altogether relied upon. Farmyard manure is undoubtedly a good manure for mown meadows, but it is not usually produced in sufficient quantity for extensive use. Where it is continuously used alone, also, the quantity of hay obtained may be right, but the quality is not always of the best.

In experiments carried out by the University of Leeds it was found that, over a period of 21 years, 6 tons of farmyard manure and a complete "artificial" manuring, consisting of 1½ cwt. of nitrate of soda, 2 cwt. of superphosphate, and 3 cwt. of kainit, applied in alternate years, gave practically the same results as 6 tons of farmyard manure applied annually, and that in addition the quality of the hay was greatly improved. The quantity produced as a result of the application of manure was almost double that on similar unmanured land.

In experiments on meadow hay on the College Farm, Aberystwyth, the use of farmyard manure and basic slag in alternate years gave excellent results both as regards quality and quantity.

Manuring of "Seeds" or Rotation Hay.—The improvement which can be effected by manuring "seeds" or rotation hay is well shown by the results obtained at Cockle Park, Northumberland. The seed mixtures used in these experiments were more elaborate than is usually the case where a field is laid down to a one-year ley, but the figures given below indicate the marked difference made, even in the first year's hay crop, by proper manuring.

		Hay Crop.
Plot 1.	10 cwt. Basic Slag per acre	39½ cwt. per acre.
„ 2.	10 tons Farmyard Manure	28 „ „ „
„ 3.	10 „ „ „ and 10 cwt. Basic Slag	38 „ „ „
„ 4.	No Manure	6¾ „ „ „

The manures were applied in November after the corn crop had been harvested.

It will be seen that there was a very great advantage in applying manures to the "seeds." Farmyard manure gave very good results when used alone, but was not nearly so effective

as basic slag, while when added to basic slag it gave no increase over the basic slag alone.

With another seed mixture the three forms of treatment gave results almost identical with the above in the first year's hay crop.

This experiment was continued for many years, the manuring being repeated every third year. The average annual results for eleven years were as follows :—

	Seed Mixture A.	*Seed Mixture B.*
Plot 1.	23¼ cwt.	34 cwt.
.. 2.	22½ ,,	30¾ ,,
.. 3.	25 ,,	33½ ,,
.. 4.	5½ ,,	9⅓ ..

A and B differed from each other only in the fact that seed mixture B contained 4 lb. per acre of wild white clover seed in addition to the seeds included in A.

These results obtained over a period of eleven years are doubly interesting, as they show the effects both of proper manuring and also the great difference obtained by the use of two different seed mixtures.

In the case of seed mixture A, there was a difference of 19½ cwt. per acre per annum, on the average of eleven years, betweeen the no manure plot and Plot 3, and in the case of seed mixture B, a difference of 24⅔ cwt. per acre per annum between the unmanured plot and Plot 1, but the differences between the manured plots were relatively small. The average difference of 3¼ cwt. per acre is, however, not negligible, and the fact that the combined dressing of farmyard manure and basic slag did not give very appreciable increases over the plots on which each was used separately is important.

The Importance of the Seed Mixture.—The above experiments emphasise the importance of using the best seed mixture. In the first year's hay crop, there was very little difference between mixtures A and B where basic slag had been used, but the addition of 4 lb. per acre of wild white clover seed resulted in an increase of 9½ cwt. of hay per acre with farmyard manure, and an increase of 11¼ cwt. per acre with no manure. Over the eleven years the 4 lb. per acre of wild white clover gave a handsome profit, equal to £4 7s. per acre per annum on the basic slag plots at present prices of slag and wild white clover. Much smaller quantities of wild white clover than 4 lb. are quite effective with proper manuring.

Experiments carried out in North Wales and elsewhere also prove the great superiority of wild white clover seed over ordinary white Dutch clover seed in the forma-

tion of permanent pastures. In some of the North Wales experiments this superiority was often clearly seen in the thicker sole of the pasture, even in the first year.

The question of white clover is obviously very important, not only in the formation of long duration pastures but even for short duration leys, as a good development of white clover in the pasture has a beneficial effect on the subsequent arable crops.

In the formation of a pasture, however, the seed mixture as a whole and the purpose for which it is intended must be taken into consideration. Seed mixtures should be designed according to the length of time the field is to be in grass and the type of soil. There are also other factors of great importance, such as the local conditions, especially altitude and climate, which need to be taken into account.

With seed mixtures for pastures of several years' duration, the problem is more complicated than in the case of short duration pastures, and in considering the question of permanent pastures the difficult period which is usually encountered between the third and the seventh years has to be considered.

The Treatment of Established Pastures.—In the formation of a permanent pasture the seed mixture is very important, although by no means all-important. On second-rate and poorer land at least, the effects of a good seed mixture can easily be destroyed by unsuitable and ungenerous treatment, while it is also true that a good pasture may ultimately be obtained by generous and careful treatment, where a relatively poor seed mixture has been used. In the latter case, however, the land does not produce its maximum over a number of years, while in the former case it hardly ever is given a chance to do so. It is very important that these pastures which are really "in the making" should be carefully managed as regards drainage, manuring, grazing, or mowing, so that they may not reach the exhausted state in which wide areas in this country are found at the present time.

Much of our semi-derelict grass land might have been much more easily saved by better treatment in the past, but it is not yet too late to mend.

Experiments in North Wales have also shown that much very poor grass land of various kinds—on peat, on thin hill loams, and on heavier soils—which had never been treated in any way, is capable of great improvement, and, generally speaking, in these experiments ground mineral phosphate and basic slag were about equally successful.

AGRICULTURE AS AN OCCUPATION FOR WOMEN.

GERTRUDE WATKIN.

EXPERIENCE gained during the Great War has made it necessary for us to reconstruct somewhat our ideas of what are, or what are not, possible occupations for women, and this applies in a greater degree to agriculture than to any other occupation.

Dairy work and poultry keeping have probably always been regarded as coming within the woman's sphere of usefulness. Except in these two special branches, however, the skilled work on a farm was in the past considered to be essentially a man's work, at any rate in England, though women were employed for unskilled and seasonal work. During a long period women worked in gangs at almost nominal wages and under very bad conditions at such jobs as stone-picking, and most of us are familiar with the sight of train loads of hop-pickers, pea-pickers and fruit-pickers leaving London and other great centres when the season comes round for the respective crops to be gathered.

When, some quarter of a century ago, the Horticultural College at Swanley opened its doors to women students, many heads were shaken and much laughter was provoked by the idea of women taking up gardening as a profession. At first there was some difficulty in finding posts for the women at the close of their training, but as time passed on and their efficiency became recognised, this difficulty gradually disappeared, and gardening was commonly accepted as being enjoyable, light work suitable to a woman's strength. While agreeing with the main conclusion as to women's capacity as gardeners, one wondered sometimes whether those who described it by the adjective "light" had ever done a really hard day's work in the garden.

A few rash souls of the weaker sex were then heard to say that, not content with the spade and the hoe, they wanted to take to the plough, the harrow, and farming generally, without limiting themselves to the dairy and the chicken-run. This was an innovation, indeed. "How could a woman farm?" was asked, incredulously. "Why, she couldn't carry a sack of wheat!" It was futile to suggest that farming does not consist entirely of carrying sacks of wheat, and, further, that there are many farmers and farm hands of the opposite sex who are also unable to perform that particular task. The argument was felt to be conclusive, backed up as it was by the thought in many peoples' minds that farming was "not quite nice" for women.

The day came, however, when our able-bodied men were called away to a grimmer task than carrying sacks of wheat, and the country was faced with the necessity of producing the last possible ounce of food in our own land. It then became obvious that if agriculture was to "carry on" under these conditions, it must rely very largely upon the help of women. Passing over the work of the Land Army, which has already been dealt with by those better qualified to write of it, I would only point out that the women of the Land Army proved that there is no branch of agriculture that *some* women, at any rate, cannot perform. Whether it is desirable that women should work regularly, under normal conditions, at certain classes of farm work is, however, open to question.

Let us first consider the wage-earners on a farm and their various duties. Among the cattle, a woman certainly should be, and almost invariably is, quieter and gentler than a man, and I think many farmers would agree that young stock thrive best under the management of a woman. Fatting stock, too, have in many cases been found to do better when looked after by women than by men. On the other hand, horse and tractor work is unquestionably beyond the strength of the average woman, and should, therefore, be left in the hands of men. Field work, such as hoeing, singling, docking, &c., can be done efficiently by women. It is not desirable, however, that women should perform such work with men, they should work in a separate group or gang, for a man's greater strength enables him to work faster than a woman, who is apt to scamp her work in order to keep up the pace, or else a man slackens off to the slower pace of the woman and is thus not worth the higher wages he receives.

Regarding the question whether agriculture offers a satisfactory opening for the woman with a little capital, there appears to be no reason why a woman should not succeeed in any branch of farming, provided that she means to make it the one real interest and aim of her life. She should find out how best she can fit herself for her chosen profession, and which branch of farming she is most suitable for. She should also find time to read the current agricultural literature. It is useless to imagine that anyone can play at farming and also make a success of it. The woman who wants to potter about her farm in the morning, play tennis or golf in the afternoon, and spend a few hours at the bridge table in the evening, would be well advised to leave the land alone, for the farmer's hand and eye must be everywhere if success is to be achieved.

My advice to the girl who aspires to become a farmer is to spend *at least* two years as a working pupil under a good farmer or farmers. Experience on more than one farm is desirable, for thereby she would be enabled to study a variety of farming methods. She would then be in a position to get the very best out of a College course, for which she should enter, working for the National Diploma of Agriculture or for a degree in agricultural science. The mistake of going direct to the College without any practical experience is often made, the student not knowing which particular branch of the subject she wishes to give most attention, and much valuable time is wasted in learning those elementary details of practical work with which she should have been already familiar.

If we assume that our student left school at seventeen or eighteen, the course of study suggested above will end when she is about twenty-three years of age, and she will be still too young to undertake the responsibility of a farm. A wiser course would be to obtain a post as forewoman or assistant on a farm, and so continue to lay up a store of experience that will prove invaluable when, as so frequently happens on a farm, things occur which defy the rules of the text-books. There is probably no occupation in the world in which experience is of such vital importance as in agriculture, and it is to this lack of experience in our college-bred agriculturists that the wide-spread distrust of the farmer for the man or woman with the Diploma or Degree is to be attributed. On this point, it is necessary to be very clear and to remove any suspicion that in this article it is intended to belittle the value of a college training. I am convinced that a thorough knowledge of the theory and science of agriculture is of the highest value to the farmer, but the college course should be preceded by an equally thorough training in the practical details of the work. Average farmers may not plough, milk, care for the horses in the stable, and drive the tractor on the farm, but unless they *can* do so, if necessary, and are capable of showing by practical demonstration how a job should be done or where a fault lies, they will be less well served than their neighbour, who, though ignorant of science, knows exactly from experience the details of farm work.

A branch of agriculture in which a few women are already employed, and which should offer a field for the energies of a certain number in the future, is research work. For this, a degree in agricultural science, and a special aptitude for the work

are essential. I venture to think, however, that if our experimental farms and research stations are to be of the utmost value to the community, the workers therein should have spent a preliminary period of two years obtaining a practical knowledge of ordinary farm work.

Finally, there is the work of the teacher. We have not yet got an Agricultural College for women such as we have in one or two places for Horticulture, but the future may see this hope realised. Meanwhile, women are employed as teachers in dairy and poultry work at various Farm Institutes, and also, in some cases, as travelling teachers under County Councils and in other ways. Here again it is above all things necessary that the teacher should have had thorough practical experience of the daily work of a commercial poultry or dairy farm, in order that the teaching given may be such as it is possible for the pupils to carry out in their everyday life.

NOTES ON MANURES FOR FEBRUARY.

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The Return from Spring Dressings of Nitrogenous Fertilisers.—In these notes emphasis has repeatedly been laid on the necessity for applying spring dressings of nitrogenous fertilisers to cereals. A demonstration on the large scale was arranged last season on wheat on Great Harpenden Field, Rothamsted, the results of which show the returns obtainable. The wheat had been preceded by a wheat crop, and this by oats; the land, however, had been given a good bastard fallowing during the fine weather of 1919, and weeds had been fairly well cleared away. The results were :—

	Control.	*Single Dressing of Sulphate of Ammonia (100 lb. per acre).*		
		Applied early, Feb. 10th, /20.	Applied March 6th.	Applied late, May 10th.
Dressed Grain, bush. per acre	28·9	28·7	29·8	31·6
Increase on manured plots	—	Nil	0·9	2·7
Wt. per bush. dressed grain	63·9	63·6	63·8	62·7
Proportion of offal grain to 100 of dressed grain	6·4	6·3	6·9	13·5
Straw, cwt. per acre ...	24·2	26·9	31·1	33·6
Increase on manured plots	—	2·7	6·9	9·4

	Control.	*Double Dressing of Sulphate of Ammonia (200 lb. per acre).*	
		Applied early, Feb. 10th, 1920.	Applied late, May 10th, 1920.
Dressed grain, bush. per acre	28·9	35·9	32 6
Increase on manured plots	—	7·0	3·7
Wt. per bush. dressed grain	63·9	63·6	62·7
Proportion of offal grain to 100 of dressed grain	6·4	6·5	15·7
Straw, cwt. per acre ...	24·2	35·9	36·9
Increase on manured plots	—	11·7	12·7

The single dressing of sulphate of ammonia (100 lb. per acre) would be regarded by many farmers as the utmost that could safely be applied, and yet the double dressing (200 lb. per acre) has proved distinctly more profitable. At its best the single dressing gave an increase of less than 3 bushels of grain and 9 cwt. of straw per acre, and when applied at the usual time and in the usual way it gave an increase just under 1 bushel of grain and 7 cwt. of straw per acre. Even at present prices the financial return is a good one.

The field is being put into wheat again for the third time, and the double dressing is being given over practically the whole area.

The experiment is further interesting as showing the influence of the time of applying spring dressings. The single dressing gave no increase of grain and only a small increase of straw ($2\frac{3}{4}$ cwt.) when applied in February, a larger return when applied in March (just under 1 bushel of grain and 7 cwt. of straw per acre), and a still larger return ($2\frac{3}{4}$ bushels of grain and $9\frac{1}{2}$ cwt. of straw) when applied in May. This high return from the late application was not expected and was probably associated with the cold dry spring following on the wet spell in April. The returns from the double dressed plot show that the late application cannot be relied on to prove satisfactory: the February dressing gave an increase of 7 bushels of grain and $11\frac{3}{4}$ cwt. of straw, while the May dressing gave only an additional $3\frac{3}{4}$ bushels of grain, though the increase in the straw was $12\frac{3}{4}$ cwt. per acre. The appearance of the plots, however, showed the danger of the late application: the leaves were dark green in colour and looked very unhealthy. Had there been much rust they would probably have suffered considerably, and in a season more conducive to growth the crop would almost certainly have lodged badly. No farmer liked the look of this plot and it was saved only by the special character of the season. The weight per bushel of the grain shows a small and probably real falling off as compared with the crop receiving the earlier applications: but the proportion of offal grain to 100 of dressed grain shows a substantial rise. Where the manures were applied early the proportion was about $6\frac{1}{2}$ per cent., and it was the same whether the single or double dressing was used—further proof that the double dressing is not excessive. When, however, the manures were applied late the proportion rose to 15.7 per cent. in the case of the double dressing, and only little less, viz., 13.5 per cent., in the case of the single dressing.

The returns from spring dressings are seen to depend very much on the time of application, but season plays so large a part that it is impossible to foretell what the result will be. Where only a small dressing is being given it may prove more effective if applied rather late, but if a larger return is sought and a larger dressing given, early application is essential and late application is highly speculative.

Nitrate of Soda or Sulphate of Ammonia for Spring Dressings of Cereals.—Now that nitrate of soda is again obtainable several correspondents are asking which is preferable as spring dressing for cereals. There is usually not a great deal to choose between them when comparison is made on the basis of equal nitrogen content. (Sulphate of ammonia contains 20 per cent. of nitrogen, while nitrate of soda contains about 16 per cent.)

On medium or light soils fairly well supplied with lime nitrate of soda is about 5 per cent. better than sulphate of ammonia containing the same amount of nitrogen. On chalk soils the difference is less or disappears altogether. On heavy soils the balance is in favour of sulphate of ammonia, since nitrate of soda is apt to bring the soil into a sticky condition which, while not as harmful for cereals as for roots, is nevertheless undesirable. On soils inclined to be sour the advantage lies with nitrate of soda, since sulphate of ammonia on sour land may cause considerable damage to the crop, especially to young seeds sown in the corn, while nitrate of soda tends to counteract the injurious effect of acidity.

Improvement of Rough Pasture.—Farmers in hill and moorland districts commonly have large areas of rough pasture which affords little subsistence to their animals. So long as it is unenclosed very little improvement is possible, but something can be done as soon as fencing can be erected. It is often supposed that a dressing of lime is the proper means of improvement, and this practice is followed in many parts of the country. Experiment has shown that lime is frequently not the best ameliorating agent: basic slag or mineral phosphate is often much better.

An interesting set of trials in North Wales* gave the following results:—

On Wet Acid Peat, by far the commonest in North Wales and no doubt in other wet hill regions also, the effect of manure was:—

1. Small where the herbage is mainly *Molinia* (Purple Heath Grass).

* Univ. Coll., N. Wales, Bangor, Repts. on Expts., 1917—1919.

2. More marked where the herbage was varied and included other grasses.

In this case phosphates led to a marked improvement, basic slag and Gafsa phosphate being equally effective; potash had less effect, as also had lime and limestone, except when used in conjunction with superphosphate.

On fairly Well Drained Acid Peat and on Neutral Peat (neither of which, however, is common), a marked improvement was effected by basic slag, although neither lime nor limestone was of much use.

The trials bring out the interesting point that farmers cannot always rely upon lime to improve poor grass land, even if it is wet and acid. This is not peculiar to North Wales. A similar result has been obtained on the poor clay soils in the eastern half of England, in regions as widely separated as Essex and Northumberland. As a general rule basic slag or mineral phosphate is more useful than lime on grass land; but the rule is not without exceptions. There are in Yorkshire considerable areas of light loam overlying and derived from Coal Measures sandstone which carry poor herbage when in grass, for which the old idea is more correct; lime has a marked beneficial effect, greater it is claimed* than that of basic slag.

The Garforth experiments show that lime is often effective on poor grass land, the results in cwt. per acre being :—

Plot.	Treatment.	Initial difference in favour of S. half, unlimed.	Average 1912–1919 (8 yrs.)		
			S. half, unlimed.	N. half, limed.	Increase, presumably due to lime.
1	Unmanured	5¾	17¼	24¼	12¾
2	Dung every year	2½	41¾	38	1¼
6	Dung and complete artificials, alternate years	1½	38¼	38½	1¾
7	Complete artificials every year	4½	27½	30¼	7¼

It is widely recognised, however, that directly sour grass is ploughed out for arable crops it must be adequately treated with lime. Farmers breaking up leys of 3 or more years' duration may lose much of the benefit of the accumulated fertility unless

* J. A. Hanley, Leeds Bull., No. 115, 1920.

they do so. One Table from Dr. Hanley's report shows this very well, the difference between "sour" grass land and "chalked" grass land as preparation for arable crops:—

Wheat (Grain and Straw) per acre obtained in 1919 from Experimental Plots on Old Pasture ploughed out in 1918.

No. of Plot.	Treatment in 1898 whilst under grass (pasture).	Northern halves of plots, Chalked 1911.		Southern halves of plots, No chalk.	
		Grain bush.	Straw cwt.	Grain bush.	Straw cwt.
1	Homo...				
2	Fine Rape Meal ... *	40½	22½	10¾	8¼
3	Coarse Rape Meal				
4	Dung	38	21½	19¾	14¾
8†	Fine Bone Meal, Kainit, Nitrate of Soda	29¾	16¾	27	15¾
9	No manure	27¾	19	15½	11
10†	Slag, Kainit, Nitrate of Soda	24¼	14	23½	13¼
14‡	Quick-lime	40½	26¼	29½	18
15‡	Gas-lime	25	16¼	22	12½

* These three grass plots were merged into one for the purpose of the wheat experiment.

† 1½ cwt. Nitrate of Soda per acre supplied annually 1899 to 1917 to both N. & S. halves of these plots.

‡ 6 tons per acre in 1898 to South halves, 3 tons per acre to North halves.

FEEDING STUFFS IN FEBRUARY.

E. T. HALNAN, M.A.,
Ministry of Agriculture and Fisheries.

AT the request of a correspondent, the feeding value of linseed has been included in the table and the consuming value of vetch and oat silage has been added. It may be well to emphasise the fact that the consuming values given for potatoes, swedes, mangolds and silage have no relation to the market value, but have been worked out on the basis of their nutritive values. That is to say, if a farmer feeds his potatoes to pigs, he is actually receiving £3 5s. per ton for them, but if he can sell the potatoes at a price well in advance of this, it will be more profitable to dispose of them and purchase other feeding stuffs such as maize or maize meal. Of course, this argument is limited by the fact that roots cannot be regarded as strictly interchangeable with other feeding stuffs, and a certain amount of roots will have to be retained on the farm in any case in order to fit in with the feeding system adopted. The cost of carriage and marketing will also have to be taken into consideration. The consuming values quoted, however, are a guide to the farmer in dealing with his surplus roots, if a market is available.

In some cases, apparently, silage has been found to have a constipating effect on live stock, but to correct this tendency a certain amount of linseed or linseed cake has been given. It would be interesting to learn whether farmers generally have found that silage has such an effect on live stock, or whether it is peculiar to a particular district or class of silage. Any information on this point from readers of the *Journal* would be welcome.

It will be noticed by reference to the table that linseed is more economical to buy as a feeding stuff than linseed cake, and that it is more profitable to consume home-grown linseed than to sell it and buy linseed cake. The chief points to bear in mind with linseed are (*a*) that it contains a considerable proportion of oil, 36 per cent., as compared with 8 to 9 per cent. in linseed cake, and (*b*) that it is desirable to grind linseed. As a general rule the farmer should be able to grind linseed without difficulty, but if there should be a tendency to clog the machine, it should

NAME.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	58/-	400	16 5	1 6	14 19	71	4/2	2·23
„ Foreign „	60/-	400	16 16	1 6	15 10	71	4/4	2·32
Oats, English „	52/-	336	17 7	1 9	15 18	59·5	5/4	2·86
„ Foreign „	41/6	320	14 10	1 9	13 1	59·5	4/5	2·37
Maize „ „	61/-	480	14 5	1 5	13 0	81	3/2	1·70
Beans, English spring	—	—	—	—	—	—	—	—
„ „ winter	70/-	532	14 15	3 1	11 14	66	3/7	1·94
„ Chinese	15/3	112	15 5	3 1	12 4	66	3/8	1·96
Peas, English blue	71/-	504	15 15	2 13	13 2	69	3/9	2·01
„ „ dun	80/-	504	17 16	2 13	15 3	69	4/5	2·37
„ „ maple	85/-	504	18 18	2 13	16 5	69	4/8	2·5
„ Japanese*	125/-	—	27 16	2 13	25 3	69	7/3	3·88
Buckwheat	—	—	—	—	—	—	—	—
Rye, English	76/3	480	17 16	1 8	16 8	72	4/7	2·45
Millers' offals—Bran	—	—	13 10	2 10	11 0	45	4/11	2·63
„ „ Coarse middlings	—	—	14 10	2 10	12 0	64	3/9	2·01
Barley meal	—	—	20 0	1 6	18 14	71	5/3	2·81
Maize* „	—	—	15 10	1 5	14 5	81	3/6	1·87
Bean „	—	—	18 15	3 1	15 14	66	4/9	2·54
Fish* „	—	—	26 0	7 12	18 8	53	6/11	3·70
Linseed	—	—	23 5	2 16	20 9	119	3/5	1·83
Cakes, Linseed	—	—	18 0	3 12	14 8	74	3/11	2·10
„ Soya	—	—	—	—	—	—	—	—
„ Cotton seed	—	—	11 10	3 5	8 5	42	3/11	2·10
„ Cotton seed decorticated	—	—	19 0	5 6	13 14	71	3/10	2·05
„ „ decorticated meal*	—	—	17 0	5 6	11 14	71	3/3	1·74
Coconut cake	—	—	13 10	3 0	10 10	79	2/8	1·43
Groundnut cake	—	—	14 5	3 9	10 16	57	3/9	2·01
„ decorticated	—	—	17 10	5 5	12 5	73	3/4	1·78
Palm kernel cake*	—	—	8 0	2 1	5 19	75	1/7	0·85
„ „ „ meal	—	—	6 0	2 1	3 19	75	1/1	0·58
Brewers' grains, dry	—	—	9 5	2 7	6 18	49	2/10	1·52
„ „ wet	—	—	1 14	0 12	1 2	15	1/6	0·80
Distillers' „ dry	—	—	11 15	2 16	8 19	57	3/2	1·70
„ „ wet	—	—	—	—	—	—	—	—
Malt culms	—	—	9 10	3 6	6 4	43	2/11	1·56
Potatoes†	—	—	3 5	0 8	2 17	18	3/2	1·70
Swedes†	—	—	1 7	0 5	1 2	7	3/2	1·70
Mangold†	—	—	1 5	0 6	0 19	6	3/2	1·70
Vetch and oat silage†	—	—	3 9	0 15	2 14	14	3/2	1·70

* Prices at Liverpool.
† Consuming value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in the larger markets, usually London, and refer to the price ex mill or store. They are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £12 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

be mixed with maize meal in the proportion of 1 part of maize meal to 7 parts of linseed.

Considerable quantities of beans which, during the late War, would have been intended for human consumption, are now being marketed as food for live stock. Several correspondents have written as to the value of haricot beans, Rangoon beans and butter beans for feeding to live stock. Samples of "Rangoon beans" and "haricot beans" submitted to the Ministry are apparently the same feeding stuff, and indicate differences in trade terms. Haricot beans and butter beans have a similar composition, but butter beans contain rather more oil, namely, 2 per cent., as against 1.8 per cent. in the case of haricot beans. In composition and feeding value, these beans resemble peas, and may be fed under all conditions where peas are used, and to the same extent, but it is advisable to soak them thoroughly in water before using. Meal prepared from these beans should prove quite suitable for pigs if well soaked in water before using. Very little information is available as to the practical points to be observed in the feeding of these beans to live stock, but there is no reason to anticipate difficulty in this matter, provided that reasonable care is exercised in their introduction into the diet.*

Palm kernel cake, at its present price is an extraordinarily cheap feeding stuff. It can be used for most stock purposes, and is valuable for milch cows and pigs.

* Information on the poisonous character of certain forms of the beans of *Phaseolus lunatus* (which covers Java, Rangoon, Lima and other beans) has been given in this *Journal* from time to time, notably p. 562, Vol. XXV., 1918.

AGRICULTURE ABROAD.

LIVE STOCK EXHIBITION IN ARGENTINA—EXPORTS OF PRODUCE FROM DENMARK—WART DISEASE OF POTATOES ON THE CONTINENT.

THE high place which British breeds of live stock occupy in the estimation of Argentine stock rearers is well shown by the opinions expressed of British classes of animals entered at the International Live Stock Exhibition held at Buenos Aires under the auspices of the Argentine Rural Society in September last. The Society holds an Exhibition every year, and it is significant that many of the breeders and stock raisers of the Argentine who enter animals have for a number of years past made purchases of British pedigree stock with which to improve their native strains.

International Live Stock Exhibition in the Argentine.

It has been the practice of the Argentine Rural Society for some years to invite the Royal Agricultural Society of England to appoint judges to adjudicate on several of the classes of live stock exhibited. In the case of the Exhibition recently held British experts were chosen to judge the Shorthorn, Hereford and Aberdeen-Angus cattle, the Suffolk Punch, Shire and Clydesdale horses, the Longwool and Blackfaced sheep, and the pigs. There was a general agreement of opinion that the Shorthorns were of excellent standard, both as regards size and quality, and the Shorthorn grand champion bull was sold for a record price. The number of Herefords exhibited was not large, but the champion was spoken of as a perfect model of the breed. The Aberdeen-Angus class was declared to be above expectation, and one of the judges remarked that the propaganda in favour of this breed during the last few years appeared to have done much to draw attention to its merits and the value of its meat. With regard to the sheep, it was considered that the breeds generally should be improved and efforts made to develop the size of the animals. The judges referred to the pigs as being, with few exceptions, of somewhat ordinary breeding. Among the Berkshires there were a number of first-class animals.

One feature of the Exhibition which is worthy of note was the considerable interest shown in an exhibit of seven bulls and nine cows of Holstein-Friesian cattle which were imported from the United States expressly for the Exhibition, and which

realised good prices at the sale. There appears to be no doubt that if in future British breeders wish to take advantage of the increasing interest which is shown in the Argentine for pedigree dairy cattle, they will have to be prepared to face an energetic competition from North America.

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Exports of Agricultural Produce from Denmark.

DENMARK, in common with most European countries, felt the pressure of war conditions in the matter of the home production of food, with serious consequences to her export trade. The factors which contributed to this decline are briefly set out in a Report on the Post-War Economic and Industrial Situation in Denmark, issued some months ago.*

It is pointed out that during the last generation and a half, Denmark has devoted herself principally to food production on scientific lines. A high stage of development has been reached in this direction by the assistance of the State in establishing agricultural schools and associations, and by the growth of the co-operative movement, which has been such a distinctive feature in Danish agriculture.

Before the War, Danish exports of agricultural produce to Great Britain in the form of animal substances were of considerable importance. The magnitude of this trade will be realised from the imports into the United Kingdom of butter, bacon and eggs in 1914, which were respectively 44 per cent., 55 per cent., and 24 per cent. of the total quantities imported. During the early part of the War, Denmark increased her export trade to Great Britain, but a decline afterwards set in, largely owing to the more attractive prices offered by Germany, who was beginning to feel the effects of war conditions.

As time went on, however, Denmark was compelled materially to reduce her exports. In normal times it had been her practice to consume margarine to a large extent instead of butter, which was a profitable item of export. The available supplies of margarine, however, were much reduced during the War. Moreover, the restrictions on the importation of feeding stuffs and fertilisers made the production of meat and dairy produce on a pre-war scale impossible. Every effort was made to meet the situation by increasing the area under crops, but bad harvests in 1916 and 1917 accentuated the difficulties, and a drastic reduction in the number of live stock

* C.M.D.955, 1920. Obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 4d. net.

kept had to be made, particularly in the case of pigs. Exports as a result, ceased entirely.

The trade has not since recovered its former place in the European markets. This has been largely owing to restrictions in shipping, the depreciation of the currency in neighbouring countries, and the high prices ruling for feeding stuffs. Her former trade with England has especially suffered. The lower prices for feeding stuffs obtaining in this country have been an influential factor in preventing a resumption of the export trade of butter and bacon on the pre-war scale, and, as a result, in default of the usual British market, the Danes have sought other markets for the disposal of their surplus products.

Farmers would be well advised to improve their markets in bacon, dairy produce and eggs, in order that, as pre-war conditions gradually readjust themselves, they may be able the more successfully to compete with Danish produce.

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Wart Disease of Potatoes: Prevalence on the Continent: Methods of Control.

THE following summary regarding the prevalence of Wart Disease of potatoes (*Synchytrium endobioticum* Perc.) in Europe, as well as the measures of control in the various countries, has been compiled from the publications of the International Agricultural Institute at Rome, and is supplemented by a report prepared by one of the Ministry's Inspectors who recently visited the Continent.

Holland.—Wart Disease has been discovered in the neighbourhood of Winschoten, near Groningen, in the north-east of Holland, where there are a few isolated cases. It is believed that the disease was introduced from Germany in infected potatoes carried by workmen. The Phytopathological Service of Holland keeps a sharp look-out for the disease, and the planting of potatoes in affected districts is prohibited. Experiments made with the object of discovering a cure failed. One Dutch variety —Ceres—was found to be immune, but it is not a very good cropper. Experiments are being continued with a number of English varieties. A Ministerial Decree of 20th March, 1914, ordered the inspection of potatoes destined for export to the United States of America. By a Decree of 13th July, 1914, the importation and transit of potatoes from certain countries may be forbidden, or only provisional admission granted. A Decree of 7th September, 1920, governs the importation and transit of

potatoes from Great Britain. Such consignments are to be in clean bags, sealed by an inspector of the Department of Agriculture, and must be accompanied by a certificate that they were grown on land free from Wart Disease.

Denmark.—So far, Wart Disease has not been observed, although many tons of potatoes have been examined. The Phytopathological Experiment Station of Denmark issues monthly bulletins on plant diseases and the methods of control, while numerous Agricultural Societies occupy themselves with the production of the best varieties of cereals, and, above all, of those potatoes which are recognised as being immune to disease. Fields devoted to such cultures are subject to rigorous control in order to guarantee the absolute immunity of the products, which are sold cheaply to members of the Societies. An Order of 28th January, 1876, prohibits the importation from America of potatoes and potato waste as well as the containers in which they are packed. By an Order of 19th February, 1914, arrangements were made for potatoes destined for the United States of America to be inspected. Arrangements have also been made with the Customs and Railway Authorities for at once reporting to the Inspection Committee the importation of potatoes from abroad.

Germany.—In Germany, Wart Disease is found in the Rhine District, especially south of Cologne, and also in the Hamburg District and in Holstein. Elsewhere, there are scattered cases, but only in the Rhine Provinces are fields attacked. In the greater part of Germany, immune varieties only are allowed to be grown where disease is present. Included in the so-called immune varieties, however, are some known to be susceptible to the disease, the reason being the difficulty experienced in obtaining adequate supplies of true immunes. Occupiers of land are required to produce seedmen's receipts for the varieties grown, and Inspectors visit infected or suspected areas and give helpful advice. Steps are being taken in the Hamburg District to issue an order making compulsory the notification of the disease and the planting of immune varieties only. No general law applicable to the German Empire as a whole exists in regard to plant diseases in general, though the matter is now under consideration. Measures against certain insects or cryptogamic diseases are embodied in laws and regulations issued by the Central Government or by the Governments of the different States in accordance with the needs of the moment. Experiments in soil disinfection at Nederpleis and elsewhere with a

series of chemicals did not give satisfaction in every respect. Dormant spores were found (1920) to retain their vitality in the soil for at least 10 years.

Norway.—In 1914, Wart Disease appeared in the Kristiansand District in two localities near Grimsmoe, and by order of the Department of Agriculture the infected plants were immediately uprooted and the soil disinfected with a 1 per cent. formalin solution, while it was strictly forbidden to plant potatoes or tomatoes in the infected zone for at least 6 years. In spite of these precautions, the disease spread in 1915 and was reported from 27 other localities. The Government spared no effort to suppress the pest. It gave special facilities for the purchase of disinfectants, it held lectures and distributed pamphlets, and, finally, it issued the Decree of 8th September, 1916, which, besides regulating the control of the disease, imposed penalties on those farmers who, instead of co-operating with the State, attempted to evade the law.

Sweden.—The disease has been reported by Eriksson as occurring near Stockholm.

Austria and Russian-Poland.—It was stated in 1920 that Wart Disease had not appeared in Austria, but was established in Russian-Poland.

France.—In "Annales du Service Epiphytics," Vol. IV, 1915, it is stated that Wart Disease does not occur in France. By a Decree of 19th December, 1910, the import of potatoes affected with "Black Scab" is prohibited.

Belgium.—Apparently the disease has not yet been recorded officially in Belgium, but there is every possibility of its existence in small gardens, as an officer of the Ministry whilst serving in Belgium during the War noted its presence near Ypres. There are no regulations dealing with it, but the nearness of centres of infection induced the Authorities to warn farmers of the serious nature of the disease.

Luxembourg.—Mr. Bintner, of the Agricultural Department of Luxembourg, told an official of the Ministry of the widespread nature of Wart Disease there.

There appear to be no definite records of its appearance in other European countries, nor indeed in other parts of the world save in the U.S.A. where it was introduced from Europe in 1912, but remained unrecorded until 1918.

Silver Leaf Order of 1919.

The Ministry desires to bring to the notice of fruit growers the serious nature of Silver Leaf Disease and the obligations placed upon them under the Silver Leaf Order of 1919.

Silvery leaves on a plum tree generally indicate that the tree is suffering from Silver Leaf Disease. If one or two branches only are affected, these should be removed and burnt. The branches must be cut back to a point where no dark stain in the wood can be found, and, if practicable, close to the main branch or stem.

When affected branches die, the fungus spreads out through the bark, and forms flat crusts or bracket-shaped bodies, on which are produced innumerable spores which spread disease. The annual loss to growers through the disease is already very considerable.

By the terms of the Silver Leaf Order of 1919, *growers must grub up and burn all dead plum trees, and cut away and burn all dead wood from plum trees, before the* 1*st April of each year, under penalty for neglect.*

Full particulars of the disease and suggested measures of control were given in an article published in the issue of this *Journal* for May, 1919, p. 162, and are also contained in Leaflet No. 302. Copies of the latter may be obtained post free on application to the Offices of the Ministry, Whitehall Place, London, S.W.1.

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Produce and Yield of Potato and Root Crops during 1920.

A preliminary statement has recently been issued by the Ministry showing the estimated total produce and yield per acre of the potato and root crops in England and Wales in the year 1920, with comparisons for 1919, and the average yield per acre of the ten years 1910-1919.

It is stated that *potatoes* were planted late as a rule, owing to the unfavourable weather of April, and the crop did not develop well on heavy land during the cold sunless summer. The tubers are therefore small in many districts and yields were reduced appreciably by disease in the south-west. The yield per acre over the whole of England and Wales is estimated at 5.8 tons, which is two-fifths of a ton below the average of the 10 years 1910-19, and practically the same as in 1919. Generally speaking crops were somewhat above average in the eastern half of the country but

considerably below in the west, the yield in the south-western counties being estimated at only 3.8 tons per acre, whilst in Lancashire only about two-thirds of an average crop was obtained. Owing to the large area, however, the total production, 3,137,000 tons, is 400,000 tons greater than in 1919, and apart from 1917 and 1918 is the largest recorded since these returns were first collected in 1885.

Turnips and swedes were sown later than usual and remained backward for the greater part of the summer, but improved considerably during September and October. The estimated yield, 14.4 tons per acre, is $1\frac{4}{5}$ tons per acre above average, and is the highest since 1910. Crops were better than usual in practically all parts of the country except in the north-western counties and in Wales, where they were considerably under average. The total production is estimated at 14,200,000 tons, which is 3,000,000 tons greater than in 1919, and 1,500,000 tons above the average of the 10 years 1910-19.

Mangolds suffered considerably in the early stages of their growth from fly, and crops were often thin and patchy, but they grew well in the latter part of the season. Over the whole country the yield is estimated at 19 tons per acre, which is practically the same as the average of the previous 10 years, and is 3 tons per acre heavier than in 1919. Yields were well above average in most counties in the eastern half of the country, but were poor in the west. The total production is estimated at 7,292,000 tons, or 1,000,000 tons more than in 1919, but 630,000 tons less than the 10-year average.

The total quantity of roots grown this year is therefore considerably greater than last year, and with the large stocks of hay, farmers have generally an adequate supply of home-grown winter keep.

Corky Scab in Potatoes: Recent Investigation.—Corky Scab of potatoes is a disease of the tuber which in earlier stages resembles closely the ordinary scab so common in some soils. Under certain conditions it becomes serious and, unlike ordinary scab, penetrates the skin; a corky or spongy appearance results. Severely attacked tubers become shapeless and show shallow depressions which are filled with a sand-like material, the "sporeballs" of the fungus. "Second growth" seems particularly susceptible to this disease and not infrequently the combined action of second growth and Corky Scab causes a tuber to have the appearance of being attacked by Wart Disease. This resemblance gives rise to the idea that immune varieties sometimes become infected with Wart Disease.

Owing to the severe attacks of Corky Scab in certain districts, more particularly in Derbyshire and Lancashire, the Ministry started a series of small experiments with a view to testing the resistance of different varieties.

It was known that some of the varieties immune to Wart Disease were particularly susceptible to Corky Scab, and unfortunately many of the gardens which were infected already with Wart Disease and where only immune varieties could be grown, proved to be infected with Corky Scab as well. Hence in the first place only varieties immune to Wart Disease were tested, although in one case "Sharpe's Express" was also tried.

Trials were undertaken at two Centres, namely, two adjoining garden plots in Derbyshire, near Stockport, and another garden plot at Gisburn, near Clitheroe in the West Riding. It was known that the soil in the Derbyshire plots was infected with Corky Scab, but less information was available concerning the Gisburn soil, although it was ascertained that the disease had been present there in former years.

In Derbyshire, where the Trials were carried out by officers of the Derbyshire Agricultural Education Sub-Committee, the following varieties were planted and the percentage attacked by the disease is given: "Great Scot" (100 per cent.); "Golden Wonder" (98 per cent.); "Flourball" (98 per cent.); "Arran Comrade" (95 per cent.); "King George" (80 per cent).

On another plot in the vicinity, only "Great Scot" and "Templar" were grown, with the result that 95 per cent. of "Great Scot" were attacked but the severity of the disease was less, and 60 per cent. of "Templar" were attacked.

At Gisburn no variety was severely attacked owing probably to the slight infection present in the soil. On the other hand the intensity and percentage of attack varied, as is shown by the following table:—

Variety.	*Percentage of diseased Tubers.*	*Intensity.*
Edzell Blue	30	Severe
Great Scot	10 to 12	General
Majestic	10	General
Bishop	10	Slight
Dargill Early	10	Slight
Sharpe's Express	9	Slight
Lochar	9	Slight
Golden Wonder	8	Slight
Arran Rose	8	General
Kerr's Pink	6	Very Slight
Tinwald Perfection	6	Slight
King George	6	Slight
Ally	5	General
Templar	4	Very Slight

Note.—The Edzel Blue were in a low-lying part of the garden.

While no variety of potato appears to possess immunity from Corky Scab, some varieties have more resistance than others.

In every instance the soil, where the potatoes were grown, was heavy and had a tendency to hold water. The experience of the Ministry with similar cases of this disease shows that it is always more severe where the soil is damp or water-logged. The natural, and probably the most efficient remedy in dealing with soils producing potatoes attacked by Corky Scab lies in proper and efficient drainage.

Foot-and-Mouth Disease.—*Kent* (*Wingham District*).—No further outbreaks have occurred in this district, and the restrictions, which are now only applicable to a small area immediately surrounding the infected place, will shortly be withdrawn.

Herefordshire.—One further outbreak has occurred in the district which was subjected to restrictions on account of the outbreak at Mordiford on the 12th December last, namely, Pixley, near Ledbury, confirmed on the 12th January, 1921. One further outbreak has also occurred in that part of Gloucestershire which was added to the Herefordshire Scheduled District, disease being confirmed at Churcham on the 22nd December last. The affected animal in this case was brought from premises at Woolridge on which disease had previously been confirmed on the 16th December.

Shrewsbury.—No further outbreaks have occurred in the Shrewsbury Scheduled District, and prohibition of movement is now maintained only in respect of a small area comprising certain parishes in the immediate locality of the outbreaks. In the remainder of the district the restrictions have been considerably modified.

Lincolnshire (*Lindsey*).—A fresh centre of disease was brought to notice by the confirmation on the 22nd December, of the existence of Foot-and-Mouth Disease on premises at Old Clee, in the Borough of Grimsby. The usual restrictions were immediately imposed over an area of 15 miles radius from Grimsby. Further outbreaks at Old Clee, in the immediate vicinity of the original disease centre, were confirmed on the 23rd and 24th December, 1920, and on the 2nd January, 1921. Outbreaks also occurred at Barnoldby-le-Beck, just outside the Borough of Grimsby, on the 31st December, and at Bradley, Grimsby, on 8th January.

On the 27th December, a fresh centre of disease was confirmed at South Ormsby, near Alford Lindsey, outside the district already subjected to restrictions on account of the outbreaks at Grimsby. It was accordingly necessary to impose restrictions over a further district in Lincolnshire, adjoining that under restrictions in connection with the Grimsby outbreaks.

A further outbreak was confirmed in this neighbourhood on another farm in the occupation of the same owner on the 3rd January.

Worcestershire.—On the 25th December, Foot-and-Mouth Disease was confirmed on premises near Droitwich. No apparent connection could be traced with any other outbreaks, and the usual restrictions were accordingly imposed over an area with a radius of 15 miles from the infected premises. This area included the City of Birmingham within its boundary.

Birmingham Abbatoirs.—On the 26th December, one of the Veterinary Inspectors of the Ministry reported that 36 animals affected with Foot-and-Mouth Disease had been found in Birmingham Abbatoirs; these had been moved there from 3 markets, including Rugby (Warwicks.), Rugeley (Staffs.) and one other market (unknown). The slaughter of all animals in the abbatoirs was immediately advised and was completed by the 29th December. The following day disease appeared amongst other animals in the abbatoirs, which had arrived from no less than 7 markets. The lesions in the affected animals were in some cases at least 5 days old, and there were reasons to suppose that other animals which had been slaughtered and disposed of in the abbatoirs had also been affected.

As the origin was probably an undiscovered centre in the Midlands, possibly connected with the Herefordshire Group, an Order was made on the 27th December, prohibiting the movement of animals into or out of an area embracing the County of Warwick and the greater part of Staffordshire, Leicestershire, Northamptonshire, Oxfordshire, Gloucestershire, Worcestershire and a small part of Derbyshire. The Order also prohibited movement of animals into the area except for slaughter, and within the area except by special licence of the Local Authority.

On Monday, 27th December, disease was confirmed on the premises of a butcher at Sheldon, Worcestershire, about 5 miles from Birmingham Meat Market, and it is thought that infection was undoubtedly conveyed thereto from the abbatoirs.

On the 8th January two further outbreaks occurred on premises in the city and one on the 11th January, apparently due to the outbreak in the abbatoirs.

Banbury District.—On the 5th January, disease was also found to exist on premises at Edgcote, near Banbury, Northants, in the district scheduled on account of the outbreaks at Birmingham. A further outbreak connected with this case was confirmed at Swalcliffe, Banbury, on the 8th January, and a third at Adlestrop, Chipping Norton, Glos., on the 8th January. It has been ascertained that the last-mentioned outbreak was the origin of the two cases near Banbury, and that the disease was of old standing.

Yorkshire (East Riding).—On 4th January disease was found to exist on premises at Halsham, near Ottringham, and the usual restrictions were imposed on that date over an area of 15 miles radius from that place.

In view of the grave danger of the spread of the disease owing to the fact that so many markets were under suspicion, special warnings were issued through the Press calling the attention of the public to the serious position which has arisen, and appealing for the co-operation of all concerned in bringing to the notice of the Authorities any case in which there is reason to suspect that Foot-and-Mouth Disease may exist.

Rabies.—*Wiltshire, Dorset and Hampshire.*—Six further cases of Rabies have occurred in this district, viz., two on the 31st December last, at Southampton and Winchester respectively, two on the 8th and two on the 11th January, in Southampton. One of the cases on the 11th January occurred in a pony. Three of the dogs were not known to have been bitten by any other dog, but in the other cases the dogs had been in contact with affected dogs.

Glamorgan.—No fresh case has occurred since that referred to in the last issue of the *Journal.*

Berkshire.—One outbreak has been confirmed, viz., on the 23rd December last in the Borough of Reading. The dog had been in the owner's possession for six years and there is no definite evidence as to the origin of disease.

London.—It is hoped that in the absence of any unforseen occurrence, it may be possible to release the outer portions of the district now subject to restrictions as regards movement out, at an early date.

Tithe Rentcharge: New Basis for Redemption.—The Ministry gave notice on 1st January that, for the purpose of the redemption of tithe rentcharge for which application is made after the 1st January, 1921, until

further notice, the "gross annual value" for the purposes of the Tithe Act, 1918, will be at the rate of £118 for each £100 of tithe rentcharge (commuted value), and the compensation for redemption will be seventeen times the "gross annual value" after the deductions therefrom prescribed by the said Act have been made.

The above figures have been settled on the recommendation of a Departmental Committee consisting of Sir Charles Longmore, K.C.B. (Chairman), Sir Henry Rew, K.C.B., and Mr. W. R. Le Fanu.

English and Welsh Seed Potatoes: Importation into Scotland.—The Ministry issued a notice to the press on 31st December last to the effect that the Board of Agriculture for Scotland have issued an Order under which the importation into that country of any "seed" potatoes grown in England or Wales is prohibited except under licence granted by that Board. Applications for the necessary licences should be addressed to the Board of Agriculture for Scotland, 29, St. Andrew Square, Edinburgh.

The Eggs (Description on Sale) Order, 1920.—The Food Controller has issued an order (No. 2408), dated 30th December, 1920, to the effect that, on and after the 3rd January, 1921, until further notice, a person shall not sell or offer or expose for sale, whether by wholesale or retail, as fresh eggs or new laid eggs or under any description of which the words "fresh" or "new laid" form part, any eggs which have been imported into the United Kingdom, unless the word "imported" or the name of the country of origin also forms part of the description.

The Egg (Prices) Order, 1919,* as amended, and the Egg (Restriction) Order, 1918,† are revoked as from the 3rd January, 1921, but without prejudice to any proceedings in respect of any contravention thereof.

Agricultural Training for Ex-Officers.—It has been officially announced that no applications by ex-officers, and men of similar educational qualifications, for grants for training in agriculture under the Ministry of Agriculture and Fisheries will be considered if received after 31st March next.

* See this *Journal*, December, 1920, p. 890.
† See this *Journal*, March, 1918, p. 1481.

NOTICES OF BOOKS.

The Chemistry of Crop Production.—(T. B. Wood, C.B.E., M.A., F.I.C., F.R.S. London: University Tutorial Press, 1920, 5s. 6d. net.) This volume sets out, in the form of a connected story, the principles of crop production.

The author assumes on the part of the reader an elementary knowledge of the principles of chemistry and a familiarity with the simple chemical and physical manipulations. The result is to present the information given in a very readable and attractive form, and the mind of the reader is not distracted by numerous digressions into matters which belong essentially to the domain of chemistry and physics.

The story is developed by easy stages. The factors of productivity are first explained, the scientific principles underlying crop production are then discussed, and the limitations of application of these principles in practice stated. The reader is then shown how to apply in a practical way the knowledge thus presented.

Although primarily intended for students, the book deserves to be read widely by progressive farmers, to whom it will prove a treasury of information on the right and effective use of manures. In this connection the chapter on the general principles of manuring is particularly commended.

The general excellence of the volume is slightly reduced by imperfect reproduction of some of the illustrations. It may be hoped that when a second edition is published certain of the illustrations will be more perfectly reproduced.

Preservation of Fruit and Vegetables.—(G. W. S. and M. D. Brewer. Cheltenham: Harley & Healing, 1s. 6d. net.) This little handbook of 59 pages has been written with a view to assisting the householder in the home preservation of fruit and vegetables, and in the making of useful syrups and drinks for the household. The material is treated in sections, dealing with the subjects of fruit bottling, canning and pulping, fruit and vegetable drying, fruit drinks, including home-made wines and liqueurs, jam-making, jellies and chutney.

The work claims to be based on practical experience. It has already passed through two editions and is now published in an entirely re-written form. An index appears at the end of the book.

Cottage Building in Cob, Pisé, Chalk and Clay. Second Edition, July, 1920.—(Clough Williams-Ellis. London: "Country Life" and George Newnes, Ltd., 7s. 6d. net.)

That a work of a technical nature such as this should produce a call for a second edition within a very few months of first publication, is sufficient proof of the interest which its subject matter has excited among that large class who want to build, but seek an escape from the delay and cost of doing so with the usual materials. Mr. Williams-Ellis is no doubt right in attributing the greater part of this welcome curiosity to the section of his book dealing with pisé building. To the present edition some extra matter is added descriptive of the small holders' cottage at Newlands Corner, built as a pisé demonstration by Mr. St. Loe Strachey. The short interval between the first and second editions has, however, deprived the author of the opportunity of utilising much new material which has since become available—for pisé

building on a modest scale is actually in progress in many directions. As Mr. Williams-Ellis somewhat plaintively remarks: "Soil quite incapable of making good pisé will none the less produce enthusiastic pisé-builders" whom he has found "valiantly struggling with stiff glutinous clay and almost pure sand." Under such circumstances there must be many failures, all of which cause "true friends of pisé to view their troubles with as much anger as sorrow" for the discredit on the new movement brought about by these incompetents. Apart from such misdirected effort, however, work has been done which it may be hoped will serve to increase the fund of experience in this hopeful method of building, and it is pardonable to mention here the Ministry's pisé buildings at Amesbury, recently under notice in this *Journal*.

The Amesbury cottages are intermediate in character between pisé de terre and pisé de craie, the soil used being a blend of the loamy material just beneath the topsoil and the disintegrated chalk underlying it. So good a surface has been attained latterly (with increasing experience in handling) that in the last cottage to be built it has been found possible to dispense with internal plastering; finishing the wall surfaces, after making good pronounced inequalities, with a brush coat of lime and sand only, or cement and sand where exceptional wear is expected. The result of this surface treatment will be carefully watched; at present it appears to be quite successful, and should it prove enduringly so, a further important economy due to this material will have been secured.

International Year-Book of Agricultural Legislation, 1919.—The International Institute of Agriculture, Rome, has recently issued its ninth Year-Book of Agricultural Legislation. The volume contains an introduction in English, in which the general course of the legislation of the world in 1919, bearing upon agriculture, is outlined. The remainder of the volume, in French, gives in summarised form, and under their relative subject heads, the various agricultural enactments, decrees and statutory orders of the chief countries of the world.

The price of the publication is 11s. 11d. Remittances should be forwarded to the General Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Leaflets issued by the Ministry.—Since the date of the list given on pages 984–5 of last month's issue of the *Journal*, the information contained in the following leaflets has been revised and brought up to date:—

No. 112.—Weeds and their Suppression.
„ 170.—The Use of Lime in Agriculture.
„ 228.—Prevention of Cruelty to Animals.
„ 244.—The Destruction of Rats.
„ 251.—Common Weeds—I.
„ 255.—The Workmen's Compensation Act, 1906.
„ 351.—The Development of Rural Industries and of Rural Social Life.
„ 360.—Growing Two Corn Crops in Succession (formerly Special Leaflet No. 50).

The following leaflets have been issued in the Permanent Series:—
No. 350.—Profitable Plums and Damsons.
„ 361.—Repair and Maintenance of Threshing Machines.

The following leaflets have been withdrawn from circulation:—
Food Production Series:—
No. 35.—Varieties of Oats for Spring Sowing.
„ 49.—Need for Caution in the Feeding of Livestock.
Special Series:—
No. 50.—Growing Two Corn Crops in Succession.

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WELBECK HERD OF PEDIGREE SHORTHORNS, the property of the Duke of PORTLAND, K.G. Young Bulls and Heifers for sale, from the best strains.—Apply, ALEX. GALBRAITH, Norton, Cuckney, Mansfield.

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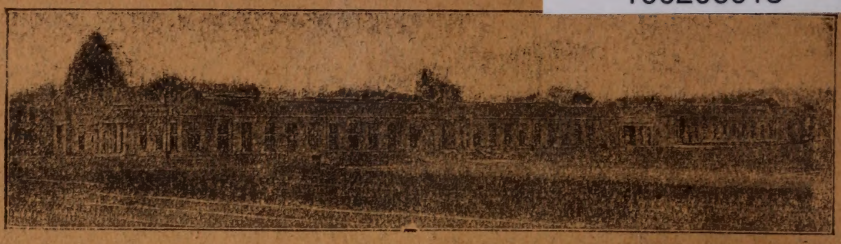

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